APEX DYNAMICS, INC.

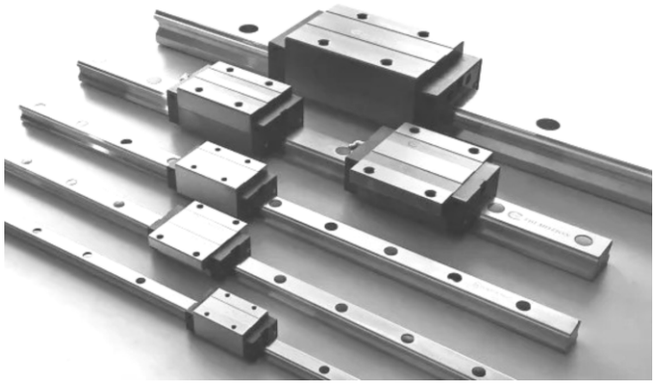
SMART LUBRICATION SYSTEM

Special Design for CNC Machine Tool With Grease of Class NLGI 1&2

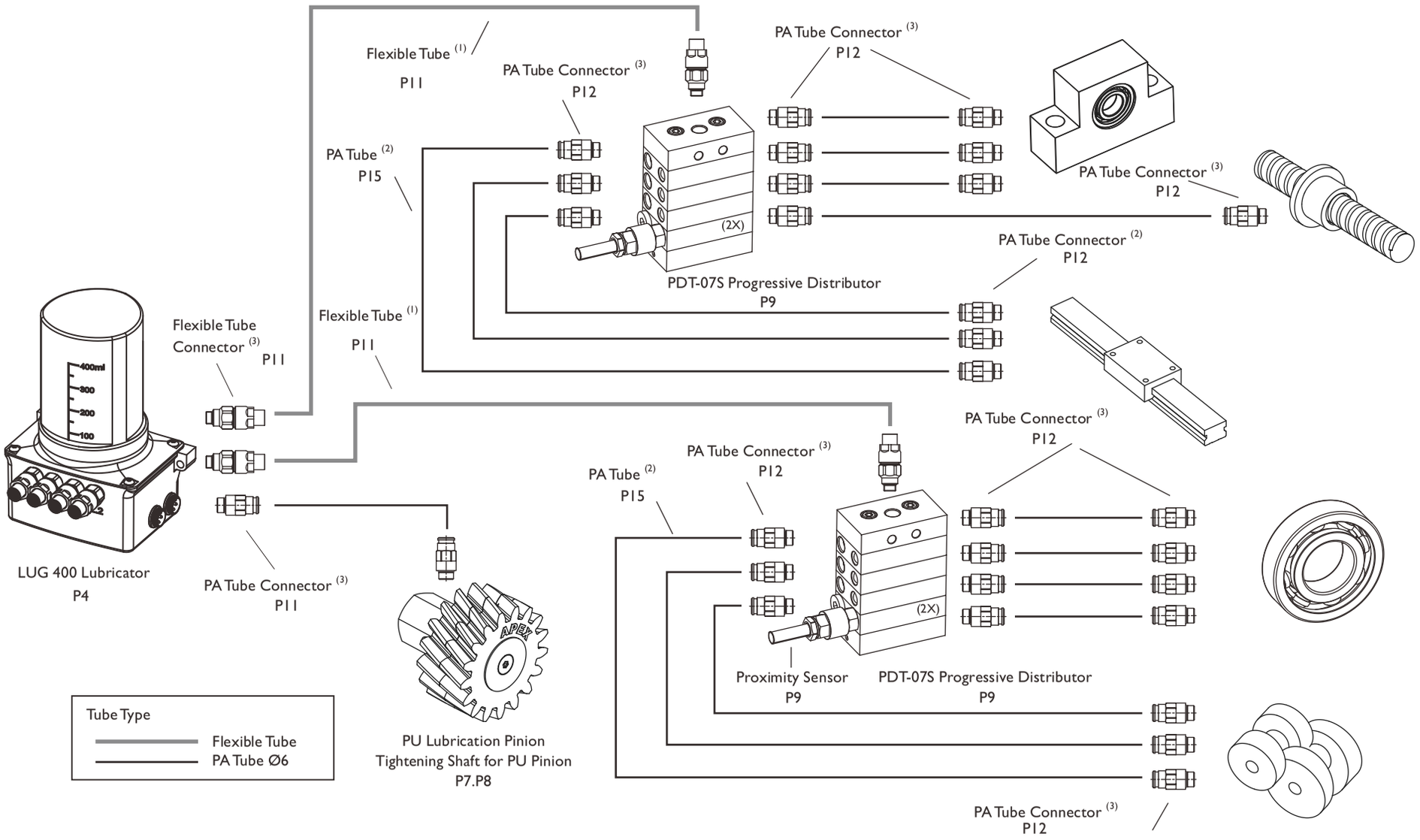
Friendly to Environment

Advantages of Grease to apply in the CNC Machine Tools

Lubricant	Grease	Oil
Consistency, Viscosity	High	Low
Compression Coefficient	High	Low
Anti-Wash-Out against Splashing Cutting Fluid	High	Low
Drops into Cutting Fluid (Tank)	No	Yes
Deterioration or Failure of Cutting Fluid	No	Yes
Friendly to Environment	Yes	No
Application Volume	Low	High
Maintainance Effort	Low	High
Running Cost Low	Low	High



Lubrication System Example of Application

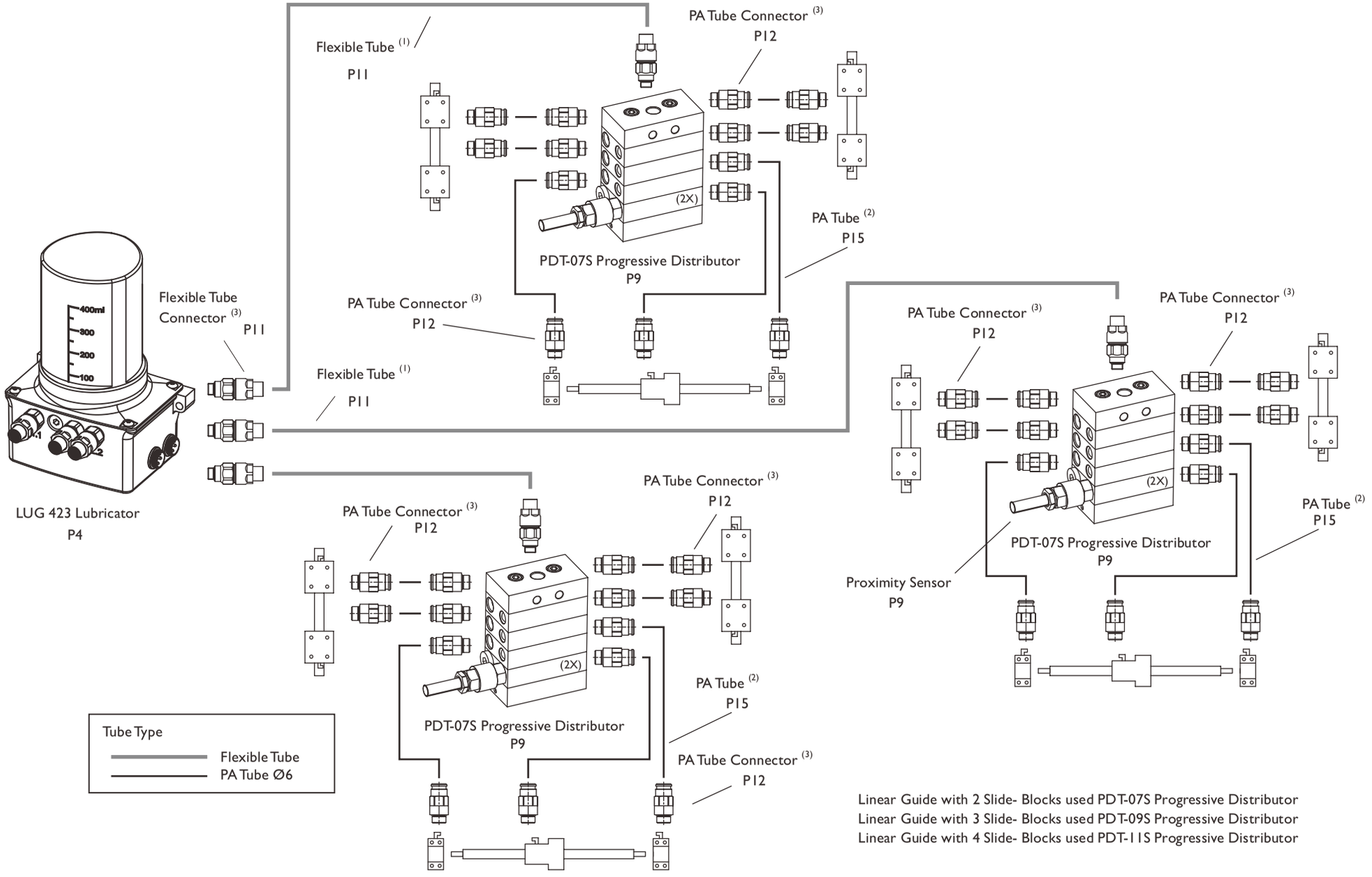


(1) Using in the main tube of lubricator, the total length of 5m (inclusive) recommended PA tube, total length> 5m recommend a flexible tube.

(2) Using a dispenser of the PA tube is suitable ø4, ø6 PA tube. When the total length of PA tube <1m and recommended ø4 PA tube, when the total length>1m and recommended ø6 PA tube.

(3) Both provide in-line connector option and right-angle connector option for flexible tube and PA tube.

Lubrication System Example of Application



Linear Guide with 2 Slide- Blocks used PDT-07S Progressive Distributor
Linear Guide with 3 Slide- Blocks used PDT-09S Progressive Distributor
Linear Guide with 4 Slide- Blocks used PDT-11S Progressive Distributor

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(3) Both provide in-line connector option and right-angle connector option for flexible tube and PA tube.

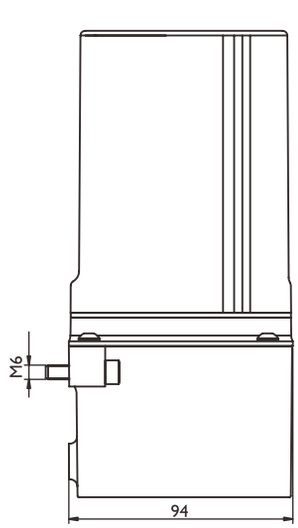
Performance - LUG 400

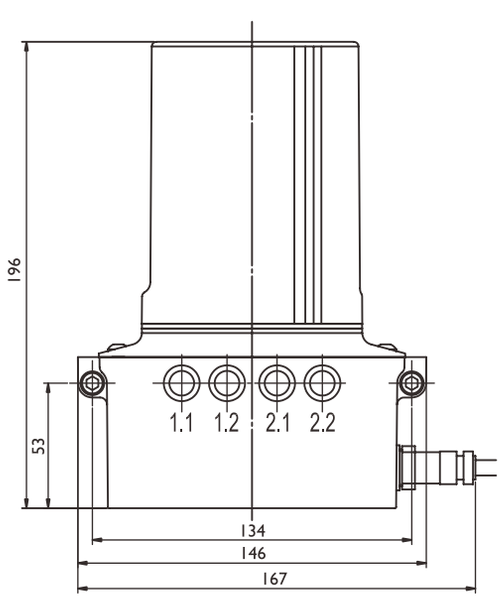
Technical Specification	
Dimension (Width x Height x Depth)	167mm x 196mm x 94mm
Weight (No lubricant)	1780g
Volume of Lubricant	400 cm^3
Lubricant Type	Grease NLGI 1~3
Pump	Piston Pump
Operating Pressure	Max. 70 bar (1,000 psi)
Delivery Volume Per Pulse/Stroke	0.15 cm^3
No. of Outlet	Max. 4 Connectors (1)
No. of Lubrication Position	Max. 44 (2)
Outlet Connection	PA Tube
Operation Voltage	24V DC
Current Consumption	$I_{max} \leq 500$ mA
Connecting Plug	M16 x 1 , 5-PIN
IP Class	IP 65
Operating Temperature	-25°C ~ 70°C
Control	PLC
Pressure Monitoring	System Pressure Measurement
Oil Fill Monitoring	Reed Switch

Lubricator

No. of Outlet	No. of Pump	No. of Lubricaion Position (1)	Order Code
1	1	max. 11	LUG-411
2	1	max. 22	LUG-412
2 (1+1)	2	max. 22	LUG-422
3 (1+2)	2	max. 33	LUG-423
4 (2+2)	2	max. 44	LUG-424

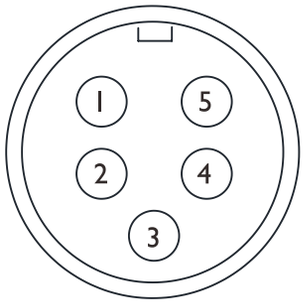
(1) Connector Dimension M10
(2) Requiring use of a Distributor





Power System

- 24V DC is applied to the Lubricator. Any electrical interference during power connection should be avoided.



5-Pin Socket

The connection between lubricator and controller via 5-Pin Socket

PIN 1 : Output Signal
PIN 2 : Input Signal
PIN 3 : FGND
PIN 4 : Input 24V DC
PIN 5 : GND

Lubrication of Rack & Pinion

- As transmission devices, Rack and Pinion are often exposed to air and may oxidized. It's highly recommended to use APEX PU Lubrication Pinion to perform greasing and uniform distribution of lubricant on all teeth surfaces.
- Open-Cell Polyurethane Foam of PU Lubrication Pinion can absorb a certain amount of lubricant. Standard Involute Teeth Design can fit perfectly the teeth of Rack and Pinion without any loading by lubrication. Under long-time operation condition, PU Lubrication Pinion provides an automatic lubrication process on transmission devices to reduce wearing, but no overlubrication.
- First soak PU Lubrication Pinion in lubricant to allow an immediate application. The Feeding Rate of lubricant depends on Module No. and Speed, can be adjusted by controller.

  Please also refer to Table A below showing Lubricant Volume vs. Module No..

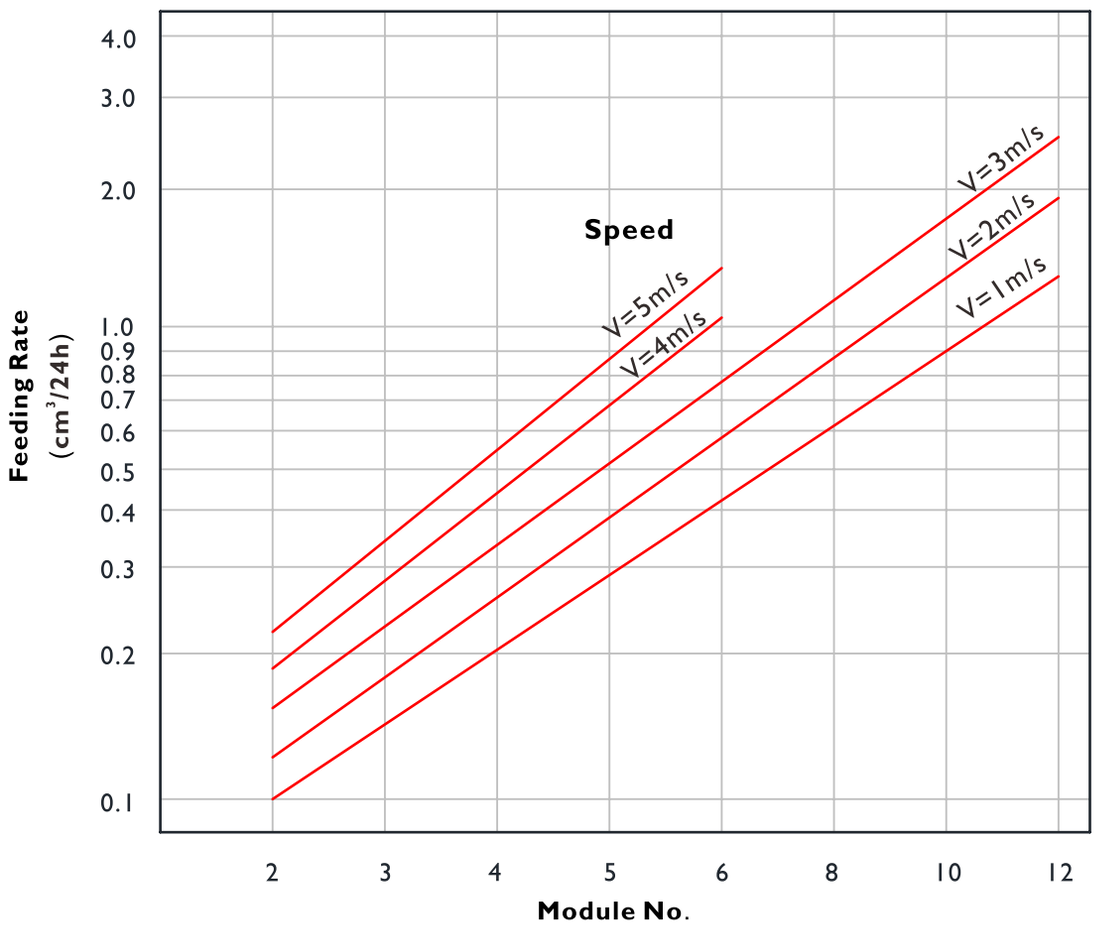


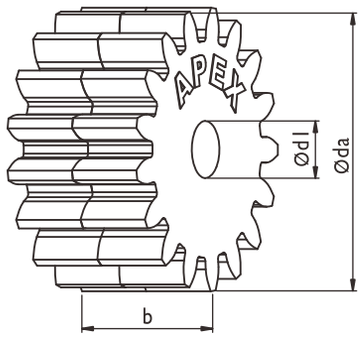
Table A

PU Lubrication Pinion

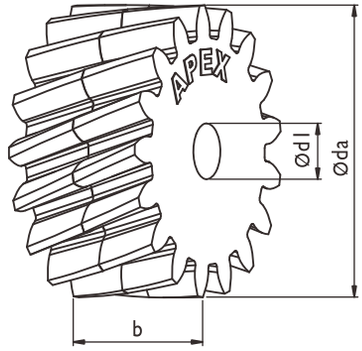
Effective Lubrication can be achieved through the use of APEX Lubrication System especially for Rack and Pinion. For uniform distribution of lubricant over rack surface, it's recommend to use a driving Pinion to allow evenly greasing.

● Lubrication Pinion

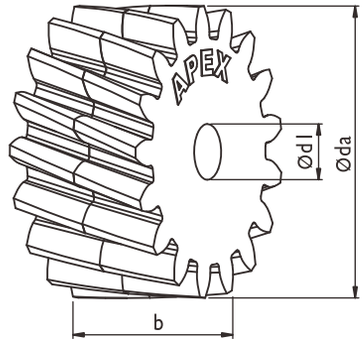
Straight Teeth



Left-Hand Helical Teeth



Right-Hand Helical Teeth



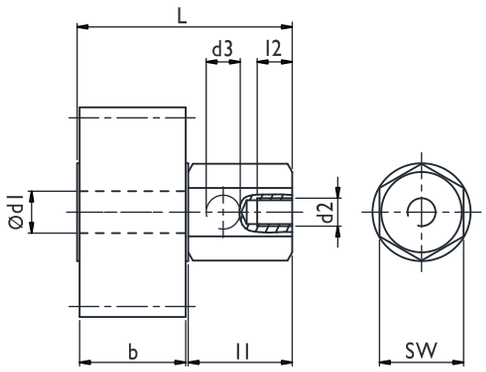
Module No.	Z (1)	Application	da (2)	dF (3)	d1	b	Order Code	Central Height a
1	36	Straight Teeth	38	36	12	15	PU-01-36S	
		Rack (Left-Hand Helical)	40.2	38.2			PU-01-36L	
		Pinion (Right-Hand Helical)	40.2	38.2			PU-01-36R	
1.5	24	Straight Teeth	39	36	12	20	PU-1J-24S	
		Rack (Left-Hand Helical)	41.2	38.2			PU-1J-24L	
		Pinion (Right-Hand Helical)	41.2	38.2			PU-1J-24R	
2	17	Straight Teeth	38	34	12	25	PU-02-17S	
		Rack (Left-Hand Helical)	40.1	36.1			PU-02-17L	
		Pinion (Right-Hand Helical)	40.1	36.1			PU-02-17R	
2.5	17	Straight Teeth	47.5	42.5	12	25	PU-2J-17S	
		Rack (Left-Hand Helical)	50.1	45.1			PU-2J-17L	
		Pinion (Right-Hand Helical)	50.1	45.1			PU-2J-17R	
3	17	Straight Teeth	57	51	12	30	PU-03-17S	
		Rack (Left-Hand Helical)	60.1	54.1			PU-03-17L	
		Pinion (Right-Hand Helical)	60.1	54.1			PU-03-17R	
4	17	Straight Teeth	76	68	12	40	PU-04-17S	$a = \frac{d + dF}{2}$ (4)
		Rack (Left-Hand Helical)	80.2	72.2			PU-04-17L	
		Pinion (Right-Hand Helical)	80.2	72.2			PU-04-17R	
5	17	Straight Teeth	95	85	20	50	PU-05-17S	$A = ho + \frac{dF}{2}$ (5)
		Rack (Left-Hand Helical)	100.2	90.2			PU-05-17L	
		Pinion (Right-Hand Helical)	100.2	90.2			PU-05-17R	
6	17	Straight Teeth	114	102	20	60	PU-06-17S	
		Rack (Left-Hand Helical)	120.2	108.2			PU-06-17L	
		Pinion (Right-Hand Helical)	120.2	108.2			PU-06-17R	
8	17	Straight Teeth	152	136	20	80	PU-08-17S	
		Rack (Left-Hand Helical)	160.3	144.3			PU-08-17L	
		Pinion (Right-Hand Helical)	160.3	144.3			PU-08-17R	
10	17	Straight Teeth	190	170	20	100	PU-10-17S	
		Rack (Left-Hand Helical)	200.4	180.4			PU-10-17L	
		Pinion (Right-Hand Helical)	200.4	180.4			PU-10-17R	
12	14	Straight Teeth	192	168	25	120	PU-12-14S	
		Rack (Left-Hand Helical)	202.3	178.3			PU-12-14L	
		Pinion (Right-Hand Helical)	202.3	178.3			PU-12-14R	
1.591 (Pt 5)	24	Straight Teeth	41.4	38.2	12	20	PU-1K-24S	
3.183 (Pt 10)	17	Straight Teeth	60.5	54.1	12	30	PU-3B-17S	
4.244 (Pt 13.33)	17	Straight Teeth	80.6	72.1	12	40	PU-4D-17S	

(1) No. of Teeth (2) Tip Diameter (3) Pitch Diameter (4) Central Distance between PU Pinion and Pinion (d = Pinion Pitch Diameter)

(5) Central Distance between PU Pinion and Rack Bottom (h_0 = Height between Rack's pitch line to bottom)

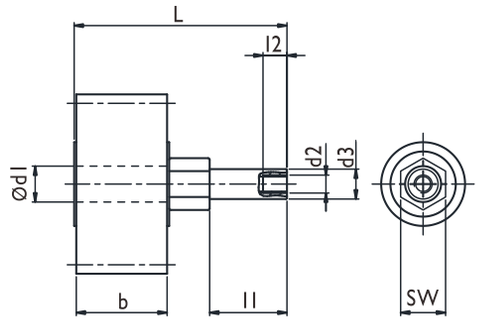
Tightening Shaft for PU Pinion

● Tightening Shaft (Right-Angle)



Module No.	L	l1	l2	b	d1	d2	Hole d3	SW	Order Code
1	46.4	30	10	15	12	M8	G 1/8"	24	AUX-01-1
1.5	51.4	30	10	20	12	M8	G 1/8"	24	AUX-1J-1
2	56.4	30	10	25	12	M8	G 1/8"	24	AUX-02-1
2.5	56.4	30	10	25	12	M8	G 1/8"	24	
3	61.4	30	10	30	12	M8	G 1/8"	24	AUX-03-1
4	71.4	30	10	40	12	M8	G 1/8"	24	AUX-04-1
5	81.4	30	10	50	20	M8	G 1/8"	24	AUX-05-1
6	91.4	30	10	60	20	M8	G 1/8"	24	AUX-06-1
8	111.4	30	10	80	20	M8	G 1/8"	24	AUX-08-1
10	131.4	30	10	100	20	M8	G 1/8"	24	AUX-10-1
12	152	30	10	120	25	M8	G 1/8"	30	AUX-12-1
1.591 (Pt 5)	51.4	30	10	20	12	M8	G 1/8"	24	AUX-1J-1
3.183 (Pt 10)	61.4	30	10	30	12	M8	G 1/8"	24	AUX-03-1
4.244 (Pt 13.33)	71.4	30	10	40	12	M8	G 1/8"	24	AUX-04-1

● Tightening Shaft (In-Line)

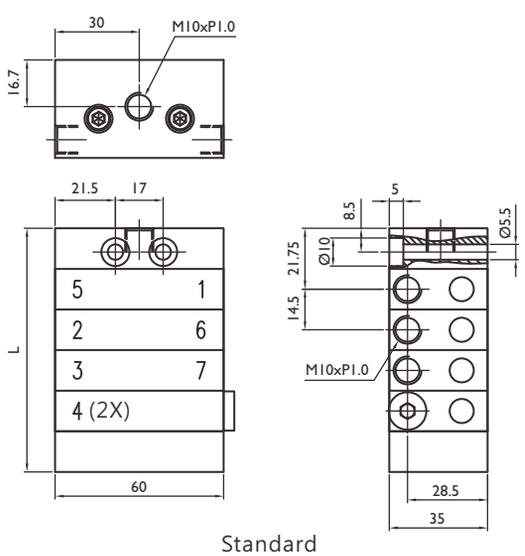


Module No.	L	l1	l2	b	d1	Hole d2	d3	SW	Order Code
1	56	30	12	15	12	M6	M10	17	AUX-01-2
1.5	61	30	12	20	12	M6	M10	17	AUX-1J-2
2	66	30	12	25	12	M6	M10	17	AUX-02-2
2.5	66	30	12	25	12	M6	M10	17	
3	71	30	12	30	12	M6	M10	17	AUX-03-2
4	81	30	12	40	12	M6	M10	17	AUX-04-2
5	116	49	12	50	20	G 1/8"	M16	24	AUX-05-2
6	126	49	12	60	20	G 1/8"	M16	24	AUX-06-2
8	146	49	12	80	20	G 1/8"	M16	24	AUX-08-2
10	166	49	12	100	20	G 1/8"	M16	24	AUX-10-2
12	186.6	49	12	120	25	G 1/8"	M16	30	AUX-12-2
1.591 (Pt 5)	61	30	12	20	12	M6	M10	17	AUX-1J-2
3.183 (Pt 10)	71	30	12	30	12	M6	M10	17	AUX-03-2
4.244 (Pt 13.33)	81	30	12	40	12	M6	M10	17	AUX-04-2

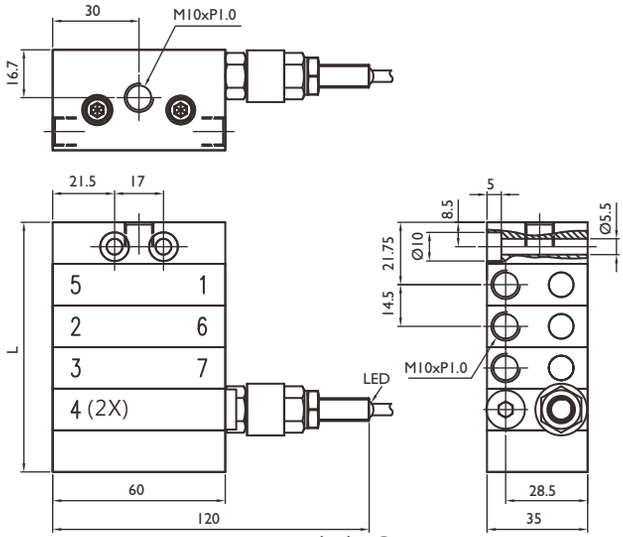
Progressive Flow Distributor

Progressive flow distributor supports multiple lubrication positions successive in the pumping cycle. The output volume by each outlet is 0.15ml, while by the outlet (2X) is 0.3ml (two strokes).

- Grease is to be apply.
- Supporting max 11 outlets
- Supporting Ø4 and Ø6 in-line and right-angle connector
- Max. permitted pressure 100 bar



Standard

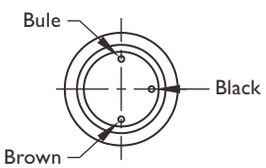
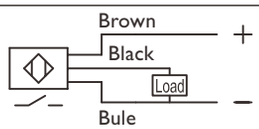


proximity Sensor

No. of Outlet	Per Stroke (ml)	Number of time for each cycle	L	Order Code	
				Standard	w. Proximity Sensor
7	0.15 (2X) : 0.3	8	87	PDT-07	PDT-07S
9		10	101.5	PDT-09	PDT-09S
11		12	116	PDT-11	PDT-11S

- Supporting standard grease NLGI 1 & 2
- Temperature range +10℃~+60℃
- Addition proximity sensor, monitoring lubrication system is available.
- To make sure entire pipe line should be full filled with grease for a correct function.
- If one outlet of distributor is blocked, the successive pumping cycle is not valid.

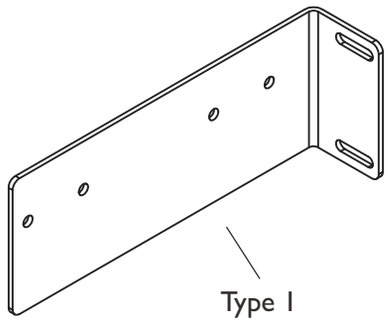
Proximity Sensor Technical Specification

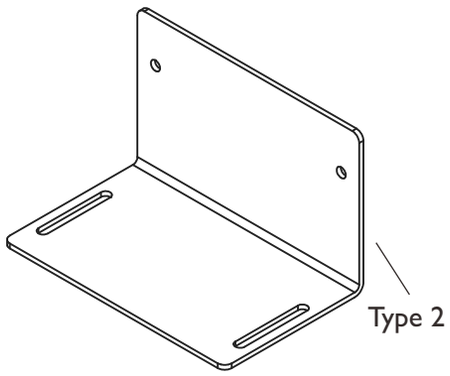
Contact Diagram 	Brown	Operating Voltage: 10~30VDC
	Black	Output Current: 150mA max.
	Bule	GND
Circuit Diagram		
Output Method		PNP
Output Status		NO
IP Degree		IP67
Order Code		Proximity Sensor : PS-01
		Proximity Sensor Connect Cable : PSL-01

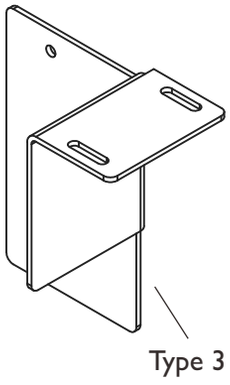
The sensor lights up when a pumping cycle of the progressive distributor has been done.

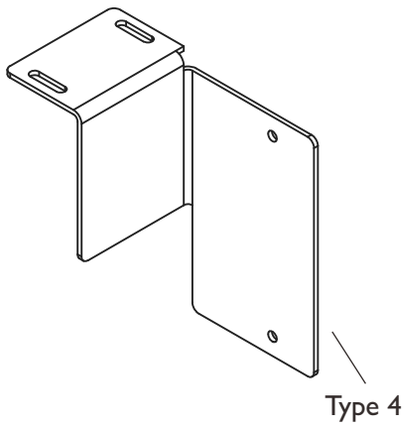
Fixing Socket

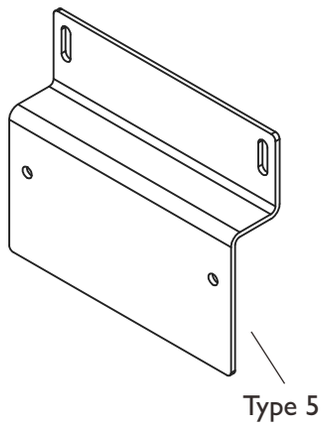
5 different types of fixing socket for LUG 400.











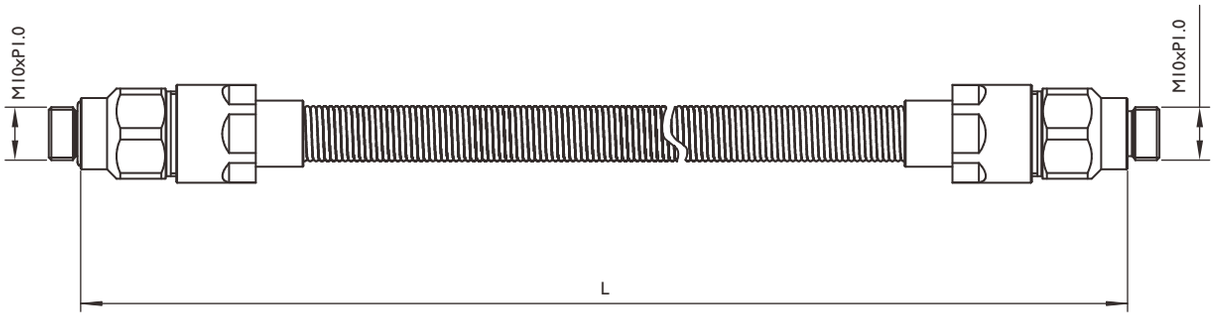
Spec	Order Code
Type 1	BK-01
Type 2	BK-02
Type 3	BK-03
Type 4	BK-04
Type 5	BK-05

- Material : SPCC
- Surface Treatment : Black flat paint
- The drawing for fixing sucket support please contact with APEX

Flexible Tube Set

To used for main lubrication pipe line. The spring is protecting tube, preventing the pipe line expansion due to high pressure and influence of pumping of grease.

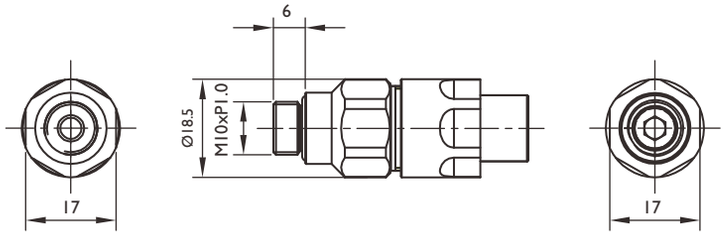
- The max length about 15 meter
- The max permitted pressure 100 bar
- Spring is coated with nickel plated and corrosion resistance.
- Operating temperature -30°C~+80°C



Length (meter)	Order Code
Approx 10	FTS08-1000
Approx 15	FTS08-1500

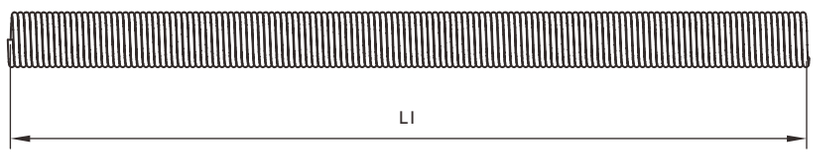
• Accessories

■ In-Line Connector
Material: Copper



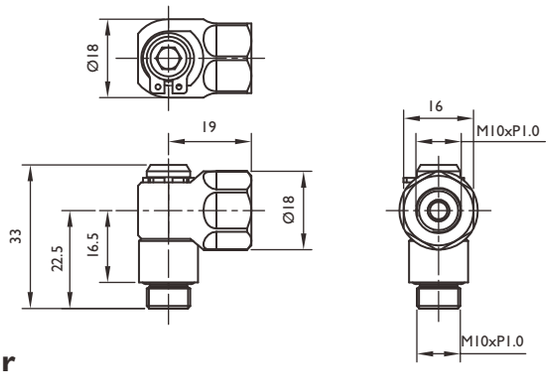
Length (meter)	Order Code
Applicable Length 10	FTC08-01
Applicable Length 15	FTC08-02

■ Protective Tube Spring
Material: Spring Steel. Surface Treatment: Nickel

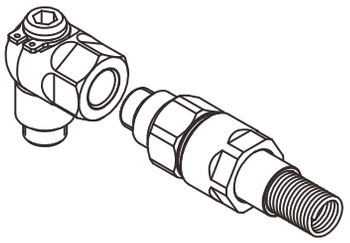


Length (meter)	L1 (meter)	Order Code
Applicable Length 10	10	PTS08-1000
Applicable Length 15	15	PTS08-1500

- Right-Angle Connector (Order Code R-FTC08-01)
  Material: Copper



Right-Angle description: Required use with In-Line connector



• Connector

- In-Line Connector

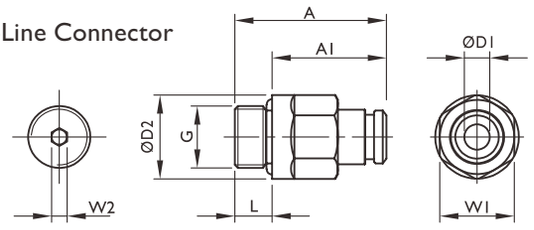


Fig A

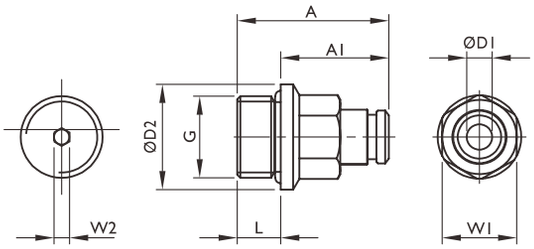


Fig B

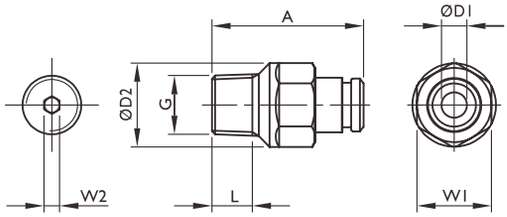


Fig C

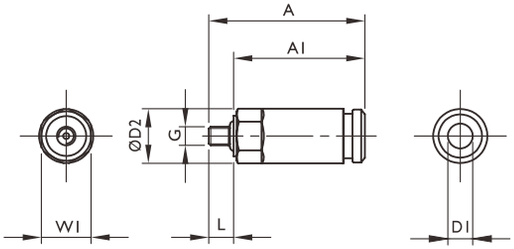


Fig D

D1	D2	A	A1	G	L	W1	W2	Fig	Order Code	
									Copper	Stainless Steel
4	8.8	25.1	21.1	M3x0.5	4	8	-	D	TB-401(1)	TBS-401
4	11.5	26.1	21.1	M5x0.8	5	10	-	A	TB-402(1)	TBS-402
4	11.5	26.1	21.1	M6x0.75	5	10	2.5	A	TB-403	TBS-403
4	11.5	26.1	21.1	M6x1.0	5	10	2.5	A	TB-404	TBS-404
4	11.5	24.4	18.4	M8x1.0	6	10	2.5	A	TB-405	TBS-405
4	13.5	24.4	18.4	M10x1.0	6	12	2.5	A	TB-406	TBS-406
4	13.5	24.4	18.4	G 1/8”	6	12	2.5	A	TB-407	TBS-407
6	13.5	30.1	25.1	M5x0.8	5	12	-	A	TB-601(1)	TBS-601
6	13.5	30.1	25.1	M6x0.75	5	12	3	A	TB-602	TBS-602
6	13.5	30.1	25.1	M6x1.0	5	12	3	A	TB-603	TBS-603
6	13.5	30.9	24.9	M8x1.0	6	12	4	A	TB-604	TBS-604
6	13.5	28.4	22.4	M10x1.0	6	12	4	A	TB-605	TBS-605
6	13.5	28.4	22.4	G 1/8”	6	12	4	A	TB-606	TBS-606
6	17	29.4	22.4	G 1/4”	7	12	4	B	TB-607	TBS-607
6	13.5	29.9	-	R 1/8”	6.5	12	4	C	TB-608	TBS-608
8	15.2	33.3	27.3	M10x1.0	6	14	5	A	TB-801	TBS-801
8	15.2	33.3	27.3	G 1/8”	6	14	5	A	TB-802	TBS-802
8	17	33.3	26.3	G 1/4”	7	14	5	B	TB-803	TBS-803

(1) Material: Carbon Steel

Operating Pressure : max. 80 bar

Operating Temperature : -30°C~+100°C

• Right-Angle Connector

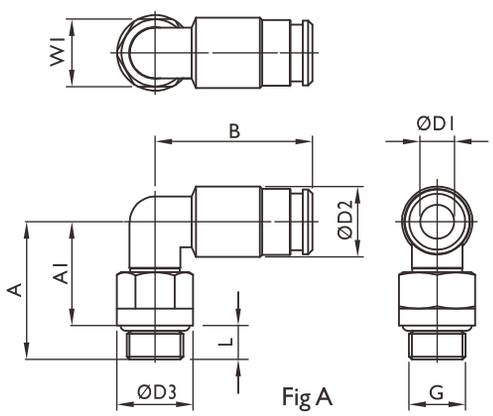


Fig A

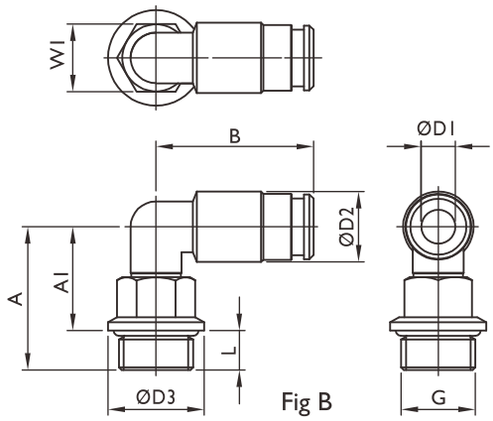


Fig B

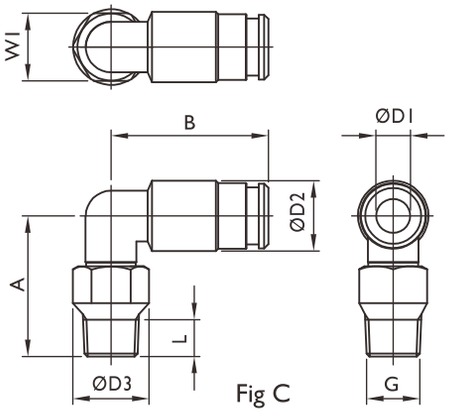


Fig C

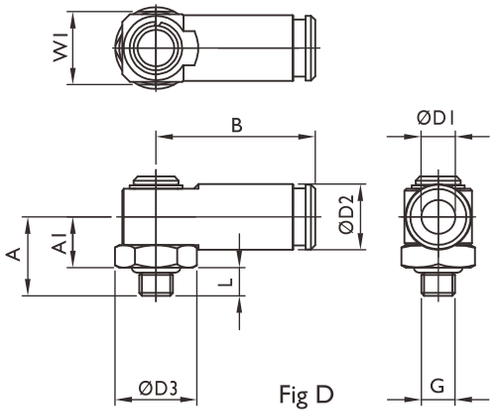


Fig D

D1	D2	D3	A	A1	B	G	L	W1	Fig	Order Code	
										Copper	Stainless Steel
4	10	11.5	18.7	14.7	22.4	M3 x 0.5	4	10	A	R-TB-401 (1)	R-TBS-401
4	10	11.5	20.7	15.7	22.4	M5 x 0.8	5	10	A	R-TB-402 (1)	R-TBS-402
4	10	11.5	20.7	15.7	22.4	M6 x 0.75	5	10	A	R-TB-403	R-TBS-403
4	10	11.5	20.7	15.7	22.4	M6 x 1.0	5	10	A	R-TB-404	R-TBS-404
4	10	13.5	23.2	17.2	22.4	M8 x 1.0	6	12	A	R-TB-405	R-TBS-405
4	10	13.5	24.2	18.2	22.4	M10 x 1.0	6	12	A	R-TB-406	R-TBS-406
4	10	13.5	24.2	18.2	22.4	G 1/8"	6	12	A	R-TB-407	R-TBS-407
4	8.8	14.5	14	9	24.2	M6 x 1.0	5	13	D	R-TB-408	R-TBS-408
4	8.8	14.5	15	9	24.2	M8 x 1.0	6	13	D	R-TB-409	R-TBS-409
4	8.8	14.5	17.5	9	24.2	R 1/8"	8.5	13	D	R-TB-410	R-TBS-410
6	12.5	11.5	21	16	27.9	M5 x 0.8	5	10	A	R-TB-601 (1)	R-TBS-601
6	12.5	11.5	21	16	27.9	M6 x 0.75	5	10	A	R-TB-602	R-TBS-602
6	12.5	11.5	21	16	27.9	M6 x 1.0	5	10	A	R-TB-603	R-TBS-603
6	12.5	13.5	23.5	17.5	27.9	M8 x 1.0	6	12	A	R-TB-604	R-TBS-604
6	12.5	13.5	24.5	18.5	27.9	M10 x 1.0	6	12	A	R-TB-605	R-TBS-605
6	12.5	13.5	24.5	18.5	27.9	G 1/8"	6	12	A	R-TB-606	R-TBS-606
6	12.5	17	25.5	18.5	27.9	G 1/4"	7	12	B	R-TB-607	R-TBS-607
6	12.5	13.5	25	-	27.9	R 1/8"	6.5	12	C	R-TB-608	R-TBS-608
6	11.7	14.5	14	9	28.2	M6 x 1.0	5	13	D	R-TB-609	R-TBS-609
6	11.7	14.5	15	9	28.2	M8 x 1.0	6	13	D	R-TB-610	R-TBS-610
6	11.7	14.5	17.5	9	28.2	R 1/8"	8.5	13	D	R-TB-611	R-TBS-611
8	14.5	14.5	25.5	19.5	29.8	M10 x 1.0	6	13	A	R-TB-801	R-TBS-801
8	14.5	14.5	25.5	19.5	29.8	G 1/8"	6	13	A	R-TB-802	R-TBS-802
8	14.5	17	25.5	19.5	29.8	G 1/4"	7	13	B	R-TB-803	R-TBS-803

(1) Material: Carbon Steel

Operating Pressure : max. 80 bar

Operating Temperature : -30°C~+100°C

• Tube Connector

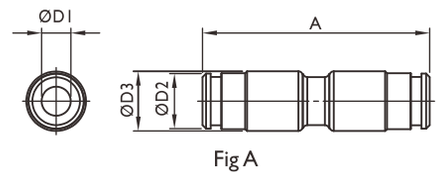


Fig A

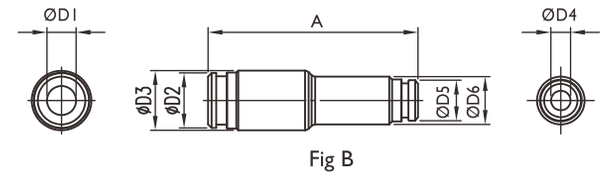


Fig B

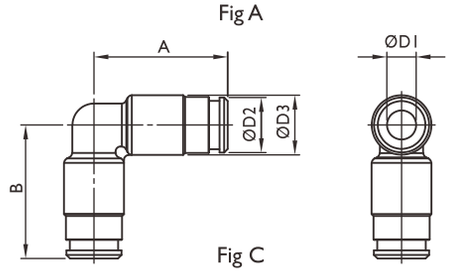


Fig C

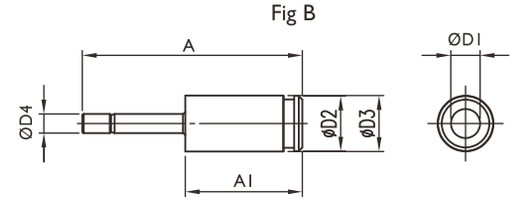
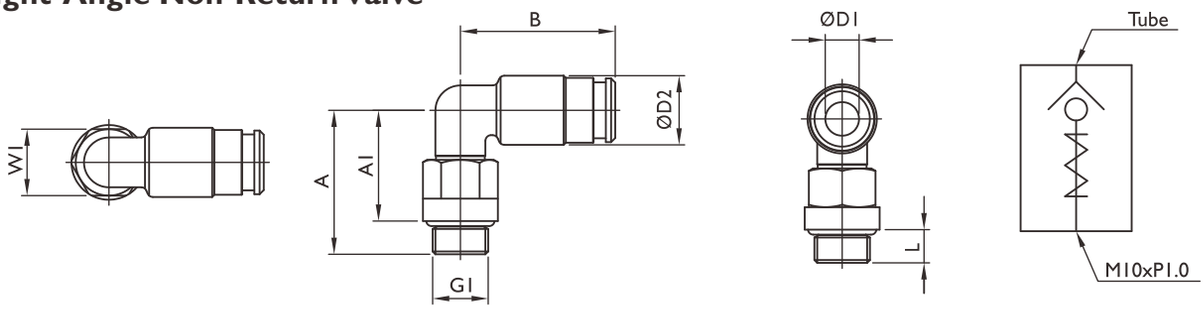


Fig D

D1	D2	D3	D4	D5	D6	A	A1	B	Fig	Order Code	
										Copper	Stainless Steel
4	8.5	10.0	-	-	-	39.8	-	-	A	C-TB-401	C-TBS-401
4	8.5	10.0	-	-	-	22.4	-	22.4	C	C-TB-402	C-TBS-402
4	8.5	8.8	6	-	-	45.4	20.4	-	D	C-TB-403	C-TBS-403
6	11.5	12.5	-	-	-	47.8	-	-	A	C-TB-601	C-TBS-601
6	11.5	12.5	4	8.5	10	43.8	-	-	B	C-TB-602	C-TBS-602
6	11.5	12.5	-	-	-	27.9	-	27.9	C	C-TB-603	C-TBS-603
6	11.5	11.7	4	-	-	45.9	24.4	-	D	C-TB-604	C-TBS-604
8	13.5	15	6	11.5	12.5	49.2	-	-	B	C-TB-801	C-TBS-801
8	13.5	13.8	6	-	-	51.3	26.3	-	D	C-TB-802	C-TBS-802

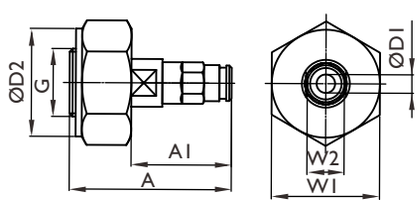
• Right-Angle Non-Return Valve



D1	D2	A	A1	B	G1	L	W1	Order Code	
								Copper	Stainless Steel
4	10	24.2	18.2	22.4	M10 x 1.0	6	12	RV-TB-401	RV-TBS-401
6	12.5	26	20	27.9	M10 x 1.0	6	12	RV-TB-601	RV-TBS-601
8	14.5	27	21	29.8	M10 x 1.0	6	13	RV-TB-801	RV-TBS-801

Function of Non-Return Valve: Avoid of backflow, Resistance of pressure.

• Oil Filling Connector



D1	D2	A	A1	G	W1	W2	Order Code
4	35	48.4	28.4	M22 x 2.0	35	12	TB-4-22
6	35	52.4	32.4	M22 x 2.0	35	12	TB-6-22
8	35	57.3	37.3	M22 x 2.0	35	14	TB-8-22

The oil filling connector is to apply for refilling of lubricant.
High kinematic viscosity of lubricant will reduce the pumping distance to the device or facility.
Pay attention to kinematic viscosity by refilling of Non-APEX lubricant.

Lubricator Cartridge

- **Empty Cartridge (Order code : G00)**

  For Self-Filling of grease.

  Oil Filling Connector is necessary

  Supports LUG-400 lubricator

- **Standard Grease (Order code : G04)**

  NLGI Grade 1

  Temperature Range -15°C~+130°C

  Good performance in high pressure and metal adhesion.

  Suitable for high loading gear transmission system.

  Suitable for high temperature environment.

  Kinematic Viscosity 180 cSt/40°C

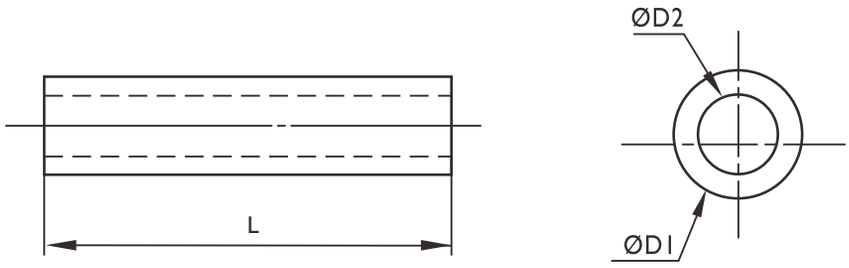
  Supports LUG lubricator pre-fill at 400 cm^3

- **Remark :**

  The APEX Smart Lubrication System has optimized as shown above.

  Using other greases, the pumping performance of APEX Lubrication System could be different.

PA Tube



Type of Grease	D1	D2	L max. (meter)	Order Code
Empty Tube	4	2.5	200	T04
	6	4	200	T06
	8	5	100	T08

Operating Pressure: 25 kg/cm2 by 4mm PA Tube; 28kg/cm2 by 6mm & 8mm PA Tube (Temperature 20°C)
Operating Temperature: -40°C~+80°C
Tube Material: PA12

It's PA tube. The maximal WORKING length of the PA tube is depending on the tube diameter and the viscosity of grease inside. The guaranteed working length is (in meter):

Grease / Tube	T04	T06	T08
Standard Grease(G04)	5m	10m	10m

Using the flexible tube set, the pumping volume of the grease will be more precise due to the non-expansion of the tube under high pressure.

Lubrication System Design Examples

CNC Vertical Machine Tool configuration is as follows

Same loading for the X and Y axis, it can be used the same transmission set.

When the spindle is rotating, request bigger transmission set to afford it.

Transmission Specification

From table A, provided seven lubrication points for each axial, the reference shown in Figure B.

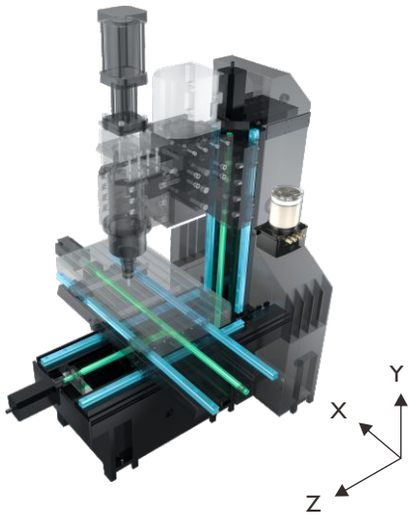


Figure A
Vertical Machine Tool

Table A Transmission Specification

Axial	Specification	Lubrication Points
X,Y Axis	Ball Screw Outer diameter 30mm	X1
	Ball Screw Support Base 2 Units	X2
	Type 25 Linear Slide 2 Sets, Slide Block for 2 Each	X4
Z Axis	Ball Screw Outer diameter 35mm	X1
	Ball Screw Support Base 2 Units	X2
	Type 30 Linear Slide 2 Sets, Slide Block for 2 Each	X4

Volume of Lubricant

According to the catalogue of manufacturer, recommend volume of lubricant.

Table B Volume of lubricant for each lubrication position.

	NO	1	2	3	4	5	6	7
X,Y Axis	Lubrication Position	Nuts	Support Base	Support Base	Slide Block	Slide Block	Slide Block	Slide Block
	Volume of Lubricant ml/hr	2.1	0.3	0.3	0.3	0.3	0.3	0.3
Z Axis	Lubrication Position	Nuts	Support Base	Support Base	Slide Block	Slide Block	Slide Block	Slide Block
	Volume of Lubricant ml/hr	2.4	0.3	0.3	0.3	0.3	0.3	0.3

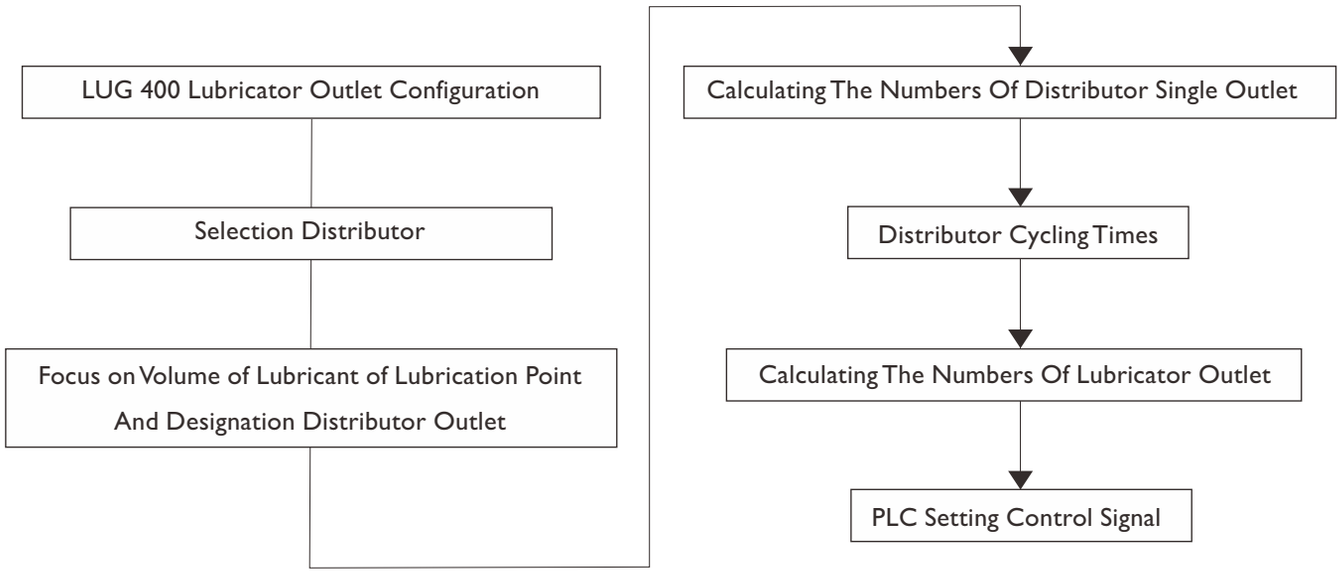
APEX used grease for the lubrication system which comparison with oil and found the advantages as following :

1. Good Adhesion: It can be attached to the friction surface and not easy to be loss it, no splash when mechanism is moving.
2. High Pressure Resistance: Great adsorption capacity from friction surface and withstand large workloads.
3. Long Service Life : Due to working on densifier pore, can be applied to high-cycle operation of the mechanism.
4. Good Protection Performance : The grease layer of grease is thicker than oil layer, when attached to a metal surface, it has strong ability to resistance moisture.
5. Good Sealing : It can be prevent dust from intruding into the working surface to avoid mechanical wear out.
6. Damping Shock Resistance: The grease with highly viscosity, and it can be absorb the cushioning effect for the parts that change the direction of motion and damping shock absorption effect.

Grease with good adhesion, extending lubrication cycle for four hours (1) .

(1) The influence for lubrication cycle will depends on the conditions and the environment, regarding to current condition.

Selection Procedures and Computation



1. LUG 400 Lubricator Outlet Configuration

Refer Table A found 3 axis require lubrication, then selected LUG 423 Lubricator(2). LUG 423 Lubricator with 2 oil pumps and 3 outlets configuration, the outlet 1.1 dispense oil and controlling by pump 1 also can be used on a single lubrication cycle independent; then 2.1, 2.2 outlet dispense oil and controlling by pump 2 therefore can be used for the same two cycles lubricating lubrication points.

Refer Table B found the volume of lubricant is the same for X,Y axis, it can be use same lubrication cycle.

So 1.1 outlet apply for Z axis lubrication, 2.1, 2.2 outlets can be apply for X,Y axis lubrication.

(2) Reference P4 lubricator section.

2. Selection Type Of Distributor

Refer Table A found 7 lubrication points for each axis, so selected PDT-07S Distributor(3).

(3) Reference P9 distributor section.

3. Specify the Distributor Outlet For Lubrication Amount Of Lubrication Points.

For every cycle and each outlet of stroke is 0.15ml, 「(2X)」 dispense oil 0.3ml. Refer Table B found the volume of lubricant of lubrication point is 2.1ml for X,Y axis nut, Z axis is 2.4ml, and rest lubrication points is 0.3ml.

According to formula A as below, can calculate the number of times which single outlet oil from the distributor.

$$\text{Number Of Times For Outlet Oil By Distributor} = \frac{\text{Volume Lubricant Of Lubrication Point}}{\text{Oil Volume For Lubrication Point by Distributor}} \quad \text{.....Formula A}$$

As X axis for example, refer Table B found the volume of lubricant is 2.1ml for Nut lubrication point, when dispense oil 0.3ml, number of times for distributor is $\frac{2.1}{0.3}$=7 times, the distributor successive outlet oil from the first hole to the last hole, which is called the distributor one cycle, so the number of times of the distributor cycle(4) is 7 times/ 4 hr.

When dispense oil 0.15ml from outlet, number of times for distributor is $\frac{2.1}{0.15}$=14times, Then the number of dispense cycles(4) is 14 times / 4 hr. Therefore, using 0.3ml outlet oil compared to 0.15ml outlet oil, will save (14-7)* 8(4) * 0.15 = 8.4ml oil.

(4) P9 distributor reference section.

4. Calculating Number Of Times For Outlet Oil By Distributor

Calculating the number of times per lubrication point according to formula A, and obtain the data sheet in Table C. Refer Table C, the lubrication points at the X and Y axis nuts are known. The single outlet oil needs 7 times / 4 hr, and the remaining lubrication points are outlet oil 2 times / 4 hr. The lubrication point for Z axis nut, for single outlet oil needs 8 times/4hr, remaining lubrication point needs 2 times/4hr.

Table C Number of times for a outlet oil from distributor

	NO	1	2	3	4	5	6	7
X,Y Axis	Lubrication Position	Nuts	Support Base	Support Base	Slide Block	Slide Block	Slide Block	Slide Block
	Volume of Lubricant ml/4hr	2.1	0.3	0.3	0.3	0.3	0.3	0.3
	Volume of Lubricant for Single Outlet Hole ml	0.3	0.15	0.15	0.15	0.15	0.15	0.15
	Number of Times for Outlet Oil/4hr	7	2	2	2	2	2	2
Z Axis	Lubrication Position	Nuts	Support Base	Support Base	Slide Block	Slide Block	Slide Block	Slide Block
	Volume of Lubricant ml/4hr	2.4	0.3	0.3	0.3	0.3	0.3	0.3
	Volume of Lubricant for Single Outlet Hole ml	0.3	0.15	0.15	0.15	0.15	0.15	0.15
	Number of Times for Outlet Oil/4hr	8	2	2	2	2	2	2

5. Distributor Cycles

As Table C, in order to satisfy the maximum oil quantity of the X and Y-axis nuts, the number of cycles of the distributor is 7 times / 4 hr.

In order to meet the maximum oil quantity of the Z-axis nut, the number of cycles of the distributor is 8 times / 4 hr.

6. Lubricator oil output calculation

According formula B to calculating the number of times for lubricator oil outlet.

Number of times for lubricator oil outlet =Distributor Cycles × Number of Strokes per Cycle(5)-Formula B

Lubricator applied to X axis 2.1 oil outlet which number of times = X axis distributor cycles × number of outlet oil per cycles = 7 × 8 = 56

Lubricator applied to Y axis 2.2 oil outlet which number of times = Y axis distributor cycles × number of outlet oil per cycles = 7 × 8 = 56

Since 2.1, 2.2 outlet was be driven by pump 2, so pump 2 actuating total for 56 + 56 = 112 times.

Lubricator applied to Z axis 1.1 oil outlet which number of times = Z axis distributor cycles × number of outlet oil per cycles = 8 × 8 = 64

Since 1.1 outlet was be driven by pump 1, so pump 1 actuating total for 64 times.

(5) P9 distributor reference section.

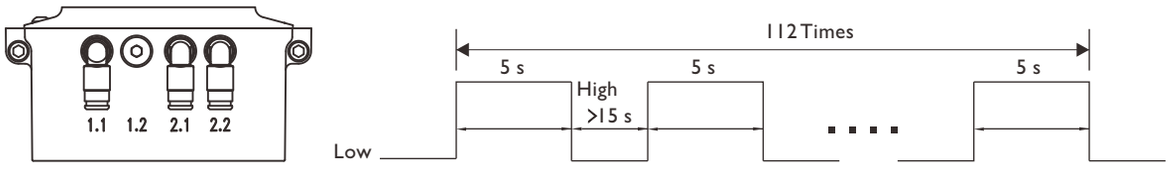
7.PLC Control[6]

When the PLC outputs different control signals to the plug PIN2[7], it can drive the oil pump, and controlling the outlet oil action of the lubricator, and achieve periodic and quantitative output functions, where in Low is 0V signal and High is 24V signal. Only one signal line sent to the lubricator by the PLC. It can't be existence of two different signals at the same time. Therefore, it is not possible to output two different signals at the same time too. The following two methods are described, and the cycle lubrication effect can be achieved.

A:

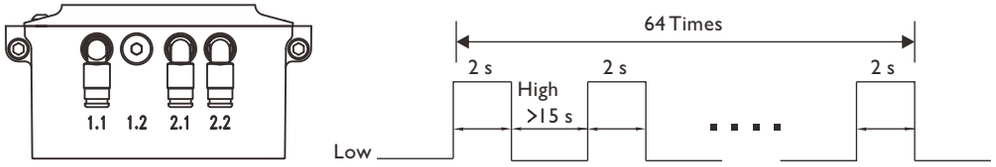
X ,Y-axis lubricator PLC control setting

Set the PLC timing every 4 hours, and when the time is up, send 112 signals from the output point for 5 seconds of HIGH signal, and please ensure that 56 HIGH signals have a time interval of at least 15 seconds. At this time, the oil pump 2 will be driven to make 2.1, 2.2 outlet to stroke oil 56 times by take turns.



Z-axis lubricator PLC control setting

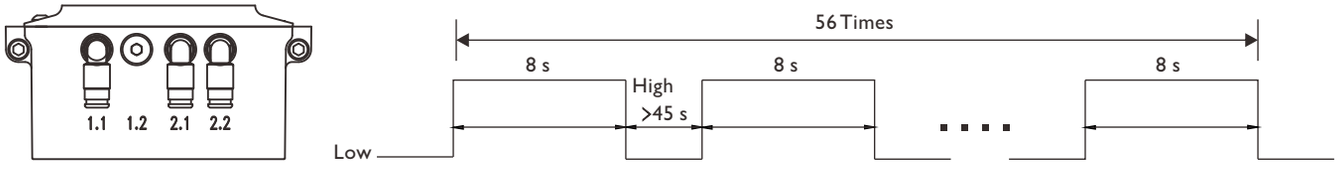
Set the PLC timing every 4 hours, and when the time is up, send 64 signals from the output point for 2 seconds of HIGH signal, and please ensure that 64 HIGH signals have a time interval of at least 15 seconds. At this time, the oil pump 1 will be driven to make 1.1outlet to stroke oil 64 times.



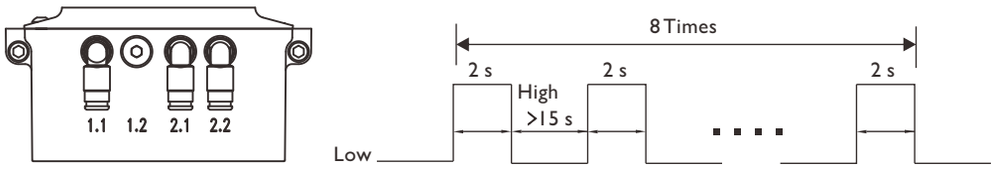
B:

XY Z-axis lubricator PLC control setting

Set the PLC timing every 4 hours, and when the time is up, send 56 signals from the output point for 8 seconds of HIGH signal, and please ensure that 56 HIGH signals have a time interval of at least 45 seconds. At this time, the oil pump 1-2 will be driven to make 1.1, 2.1, 2.2 outlet to stroke oil 56 times by take turns.



At this time, X and Y axis lubrication points have met outlet oil for 56 times; but still lacking 8 times of outlet oil for Z axis lubrication point (64-56=8), so it required output 8 signal 2 seconds of HIGH signal, and please ensure that 8 HIGH signals have a time interval of at least 15 seconds. At this time, the oil pump 1 will be driven to make 1.1outlet to stroke oil 8 times.



(6) Refer to LUG 400 lubricator Manual,3.2 PLC mode 0 various control signals section,Appendix A-1 PLC mode 0 control section.

(7) Refer to P5 power supply wiring section.

Proximity Sensor Detecting Application Instruction

In addition proximity sensor detecting device of the distributor, when the piston rod of the proximity sensor is circulating oil from the distributor, generates an evaluable signal through the proximity sensor, and thus monitoring the whole lubrication system. The Sensor output signal cannot be converted, on behalf of distributor abnormal, it is possible to pipe blockage or the other reason, please refer "Troubleshooting" section processing.

Lubrication System Architecture

The figure below shows the lubrication system architecture diagram of CNC Vertical machine tool.

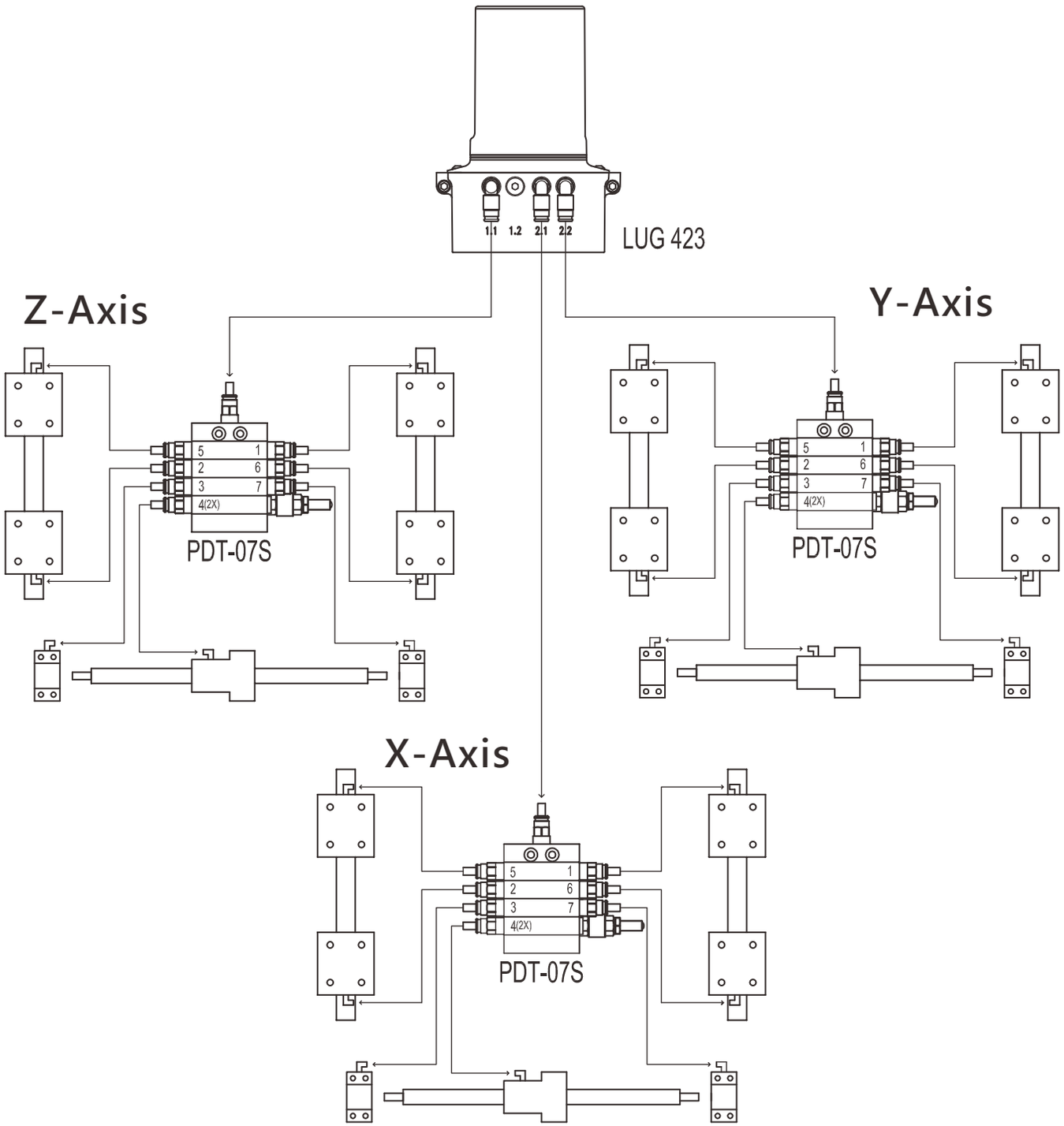


Figure B Lubrication System Architecture

Trouble Shooting

Failure / Error	Cause	Process
Lubricator		
Unable to Dispense Grease	A. No Grease into Cartridge	A. Replace Cartridge
	B. Motor Idling	B. Contact APEX
	C. Fuel Sensor Failure	C. Contact APEX
Grease Leak	A. Wear or Breakage of the Seal	A. Replace
	B. Confirming Locked for the Connector	B. The Correct Tightening Torque Locking
Main Tube for Lubricator		
Unable to Dispense Grease	A. Refer 「Lubricator」 Unable to Dispense Grease Item	
	B. Main Tube Damage	B. Replace Main Tube
	C. Main Tube Blockage	C. Confirm the Cause and Eliminate Obstruction
Main Tube Contains Trapped Air	A. Cartridge Contains Trapped Air	A. Replace Cartridge
	B. Main Tube Damage	B. Replace Main Tube
	C. Improper Assembly for Main Tube and Connector	C. Indeed Assembly
Distributor		
Unable to Dispense Grease	A. Refer 「Main Tube of Lubricator」 Main Tube Unable to Dispense Grease Item	
	B. Distributor Blockage	B. Replace Distributor
	C. Distributor not Fully Fill With Grease	C. Initial be sure to fill up with Grease before dispense oil
Grease Leak	A. Confirming Locked for the Connector	A. The Correct Tightening Torque Locking
Feed Grease Tube for Distributor		
Unable to Dispense Grease	A. Refer 「Distributor」 Unable to Dispense Grease Item	
	B. Feed Grease Tube Damage	B. Replace Feed Grease Tube
	C. Feed Grease Tube Blockage	C. Confirm the Cause and Eliminate Obstruction
Feed Grease Tube Contains Trapped Air	A. Refer 「Main Tube of Lubricator」 - Feed Grease Tube Contains Air Item	
	C. Feed Grease Tube improperly assembly with connector set	B. Indeed Assembly
	C. Feed Grease Tube Damage	C. Replace Feed Grease Tube
Proximity Sensor		
Sensor Output Signals Can Not be Converted	A. Refer 「Main Tube of Lubricator」 Main Tube Unable to Outlet Grease Item	
	B. Feed Grease Tube Blockage from Distributor	B. Confirm the Cause and Eliminate Obstruction
	C. Proximity Sensor Damage	C. Replace Proximity Sensor

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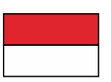

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