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Double Displacement High Speed

Radial Piston Hydraulic Motors

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Cat: provisional catalogue 2005 050414.2P

BD SERIES
MAINTENANCE MANUAL

MANUALE MANUTENZIONE SERIE BD

Double Displacement High Speed

Radial Piston Hydraulic Motors

Hydraulic Motors

Cat: provisional catalogue

Index

Introduction

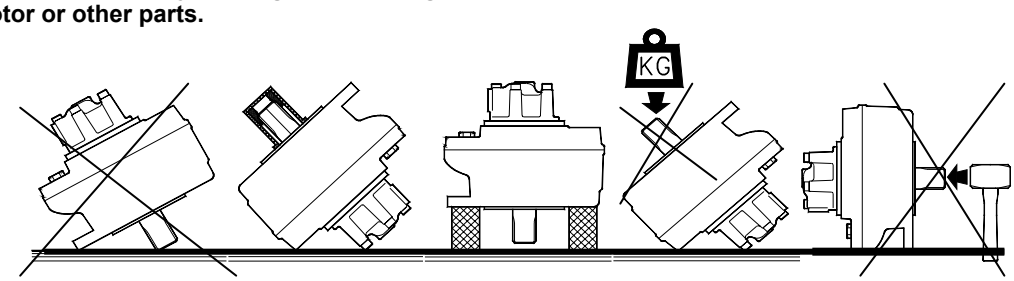
Use of this Manual

This manual includes information for the normal operation, maintenance, and servicing of the BD family of hydrostatic motors.
The manual also includes the description of the units and their individual components, troubleshooting information, adjustment instructions, and minor repair procedures.
Unit warranty obligations should not be affected if maintenance, adjustment, and minor repairs are performed according to the procedures described in this manual.
Many service and adjustment activities can be performed without removing the unit from the vehicle or machine.
However, adequate access to the unit must be available, and the unit must be thoroughly cleaned before beginning maintenance, adjustment, or repair activities.
Since dirt and contamination are the greatest enemies of any type of hydraulic equipment, cleanliness requirements must be strictly adhered to. This is especially important when changing the system filter and during adjustment and repair activities.
For further information refer to BD Technical Information.
For information about fluid requirements refer to SAI.
A worldwide network of SAI Authorized Service Centers is available should repairs be needed. Contact any SAI Authorized Service Center for details. A list of all Service Centers can be found in SAI brochure .

Order codes	
MOTOR CODE BD - (1) (2) (3) (4) + (5) (6) ; (7) (8)	
• **1** Nominal displacement:	see motor displacement table
• **2** Shaft Options:	9 = female 40-3-12 DIN 5480 10=female 65-3-20 DIN 5480 2 = tapered keyed 8 = cylindrical keyed
• **3** Bearings:	H= standard roller bearings GP= spherical roller bearing on motor cover side G = spherical roller bearings
• **4** Other options:	SV = stainless steel shaft sleeve A = high pressure shaft seal (5 bar cont. 10 bar peak) V = Vyton seals I = case press. Relief valve U = without shaft seal
• **5** Distributor:	• D40 1 ''BSP • D47=1" SAE 3000 psi • D90= 1,5" SAE 6000 psi
• **6** Tachometer:	K = Predisposed for tachometer J = with tachometer coupling
• **7** Direction of shaft rotation:	L = anti-clockwise rotation R = clockwise rotation
• **8** Distributor cover position: no code = position DM1	no code = position DM1 J = with tachometer coupling

PACKING, HANDLING, TRANSPORTING AND STORING MOTORS

Make sure that the shaft of the motor is not loaded in any way and is protected from knocks/ contact with hard surface. This may damage the bearings inside the motor or other parts.

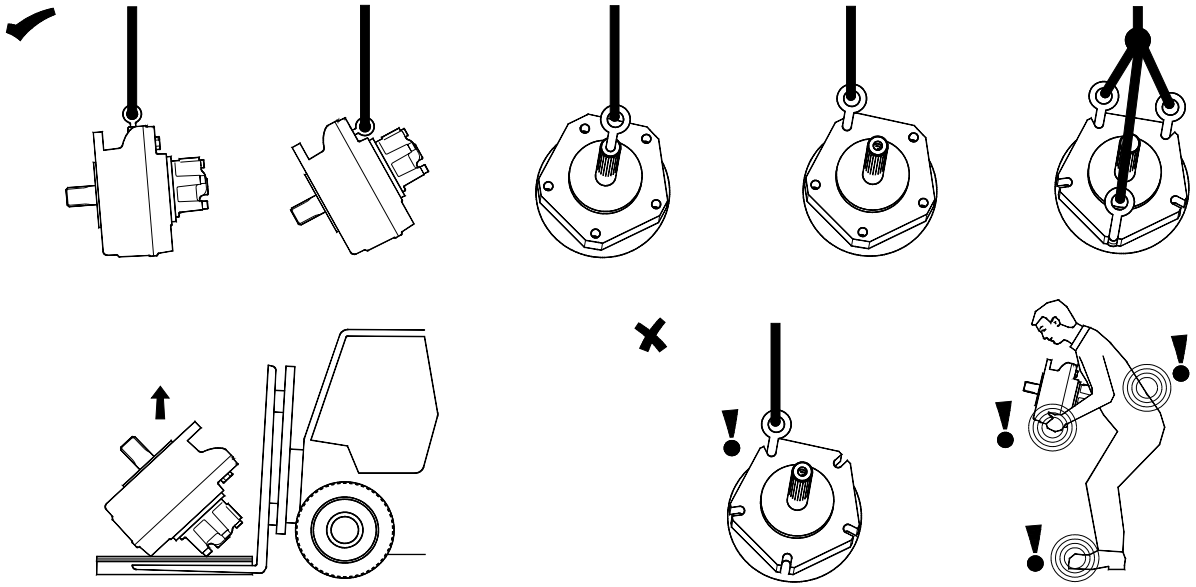


-Cover the shaft with a protective layer or element(e.g cover the shaft with tape or use a tubular element or cover made of plastic or metal)
-Do not pack or store the motors with the shaft pointing downwards so that the weight of the motor is on the shaft.
-Pack the motors in closed crates or boxes so that they are immobilised inside the crate ,do not wedge the shaft against any other surface.
Make sure that all the oil supply, discharge, drainage or other motor ports are closed.
-Tightly close all ports using suitable plastic plugs or other system suitable for this purpose.
-Store the motors in a dry environment, protected from extreme temperatures and corrosive substances(eg.salt).
-If the motors have to be stored for long period or is exposed to unfavourable conditions during transport, completely fill the motor with hydraulic oil (fill the motor casing as well as the cylinders and oil supply channels).

Carefull!

If ports are not tightly sealed dirt, water or other materials may penetrate inside the motor and possibly damage the working surface of the motor.
Rusting of the internal surfaces of the motor make the motor unusable : rust ruins the working surfaces and rust particles dislodged enter into the hydraulic circuit, contaminating the oil.

HANDLING



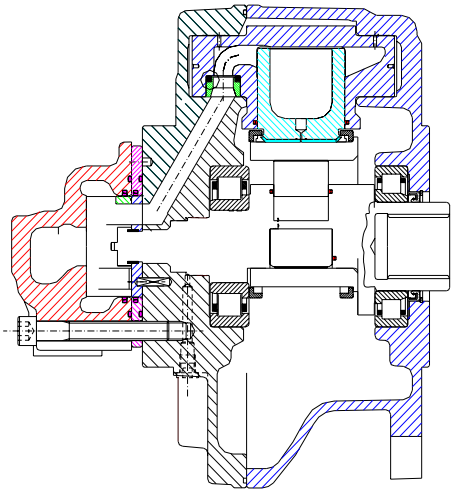
Lift and move the motors using appropriate lifting and handling equipment, making sure the motors are not free to move unrestrained.
Use eyebolts screwed into available holes in the motor cover/body in smaller motors. Special eyebolt holes are provided on the side of the motor for handling purpose.
Do not handle the motors manually.

Fluid under High Pressure

Safety Precautions

Observe the following safety precautions when using and servicing hydrostatic products.
Flammable Cleaning Solvents :
Disable Work Function
Loss of Hydrostatic Braking Ability

WARNING
Use caution when dealing with hydraulic fluid under pressure. Escaping hydraulic fluid under pressure can have sufficient force to penetrate your skin causing serious injury. This fluid may also be hot enough to burn. Serious infection or reactions can develop if proper medical treatment is not administered immediately.



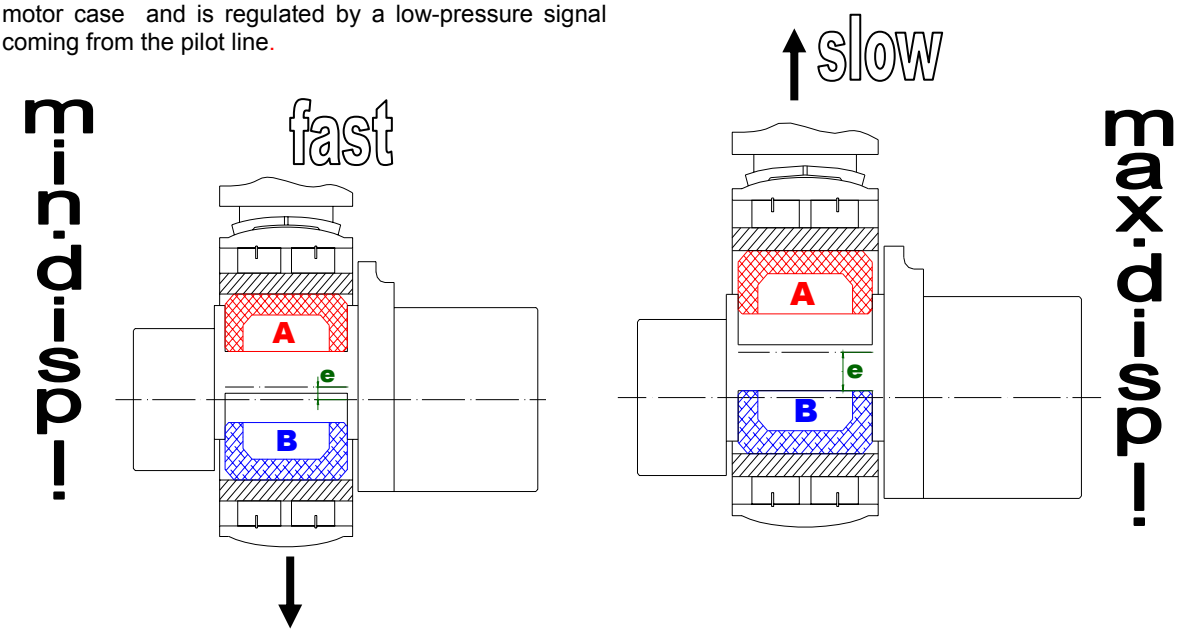
WARNING
Some cleaning solvents are flammable. To avoid possible fire, do not use cleaning solvents in an area where a source of ignition may be present.

WARNING
Certain service procedures may require the vehicle/machine to be disabled (wheels raised off the ground, work function disconnected, etc.) while performing them in order to prevent injury to the technician and bystanders.

WARNING
The loss of hydrostatic drive line power in any mode of operation (e.g. acceleration, deceleration, or neutral mode) may cause the loss of hydrostatic braking capacity. A braking system, redundant to the hydrostatic transmission must, therefore, be provided which is adequate to stop and hold the system should the condition develop.

Two Displacement Motor

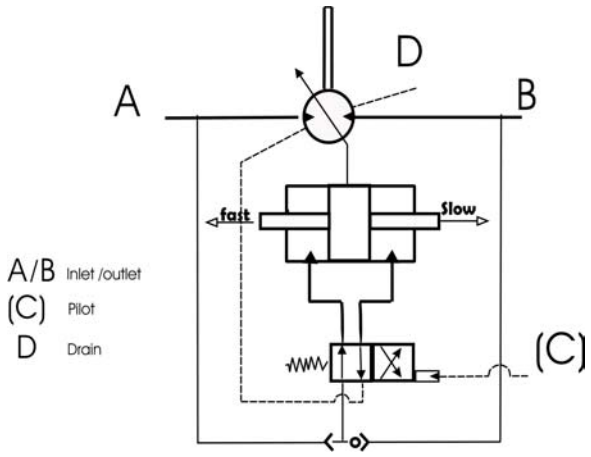
The Two Displacement Motor (BD) operates in the same manner as the fixed motor.
The dual displacement is achieved by the use of a mobile bushing mounted on the crank of the shaft capable of varying its eccentricity with respect to the axis of rotation of the shaft. Inside the crank, indeed there are three high-pressure operated pistons supplied by the high pressure line shifting the bushing outwards or inwards hence changing its eccentricity , therefore the displacement. The control system is placed inside the motor case and is regulated by a low-pressure signal coming from the pilot line.



However, it can be switched between minimum and maximum to adjust torque or speed.

Equivalent Hydraulic Sketch

The inlet and outlet ports are connected to the shuttle valve which selects the high pressure. A special valve directs the high pressure toward the corresponding chamber inside the crankshaft to switch from min. to max displ.



CASE DRAIN AND HEAT EXCHANGER
Generally motor requires case drain lines to remove the drain oil from the system. The motor should be drained from its topmost drain port to ensure the case remains full of fluid. The motor case drain can be plugged under SAI specific approval as SAI motor can be modified to keep till 10 bar peak in the case . For further information refer to BD Technical Information.

Common Features of all SAI Motors

Shaft output and distributor valve

Series BD motors can be supplied with a variety of shafts for almost any configuration. Motors have distributors with both ports on one side ("SAI standard "). Alternatively other distributor configurations are available. See the Series GM Technical Information manuals for information on available options.
Removing the sealed lead in the head of socket head screw of the distributor will void the warranty on a Series BD motor.
Two Displacement Motors weights
BD1 Kg 36
BD2 Kg 55
BD5 Kg 170

Required Tools

The service procedures described in this manual for Series BD motors can be performed using common mechanic's tools. Special tools, to be required are shown here below.

1. **tool for roller bearing to fit in.**

2. **clamp for trunnion packaging to fit cylinders in motor body.**
3. **tool for sph.roller and ball bearing to disassemble.**
4. **tool to fit in the shaft seal.**
5. **tool for motor cover disassembly.**
6. **tool for roller bearing disassembly.**

Initial Start-Up Procedure

The following start-up procedure should always be followed
when starting-up a new Series BD installation or
when restarting an installation in which the
motor had been removed.

MOUNTING
Before mounting any hydromotor ensure that it has not been damaged during transportation.
The motors must be mounted with correct size of bolts (refer technical catalogue) onto a rigid structure capable of withstanding the weight of the motor, torque reaction forces and the vibrations during operation.
Particular attention to be given as regards to concentricity of the shaft with respect to the spigot in order to avoid pre-stressing the motor shaft bearings.

DRAIN-LINE POSITIONING
The drain-line must be positioned in such a way that there is always sufficient oil in the casing for the lubrication of the shaft bearing.
If the motor is installed with the shaft in a horizontal position the drain-line should be connected to the uppermost drain-line hole.
If the motor is installed with the shaft pointing upwards, the motor casing has to be entirely filled with oil before being installed and the drain-line connected in such a way that no air can enter into the motor casing to avoid the bearing on the body to run dry.

START-UP

Prior to installing the motor, inspect the units for damage incurred during shipping and handling. Make certain all system components (reservoir, hoses, valves, fittings, heat exchanger, etc.) are clean prior to filling with fluid. Fill the reservoir with recommended hydraulic fluid. This fluid should be passed through a 10 micron (nominal, no bypass) filter prior to entering the reservoir. The use of contaminated fluid will cause damage to the components, which may result in unexpected vehicle/machine movement.
See the publications GM Maintenance Manual
for further related information.
Before connecting any tubes ensure that they are thoroughly clean, any excess material that could work loose should be removed and there should not be any oxidation of surfaces that come into contact with the oil.
Before starting work, the hydraulic circuit should be purged of air. This can be achieved by running the motor without load for at least 10 minutes, during which time checks should be made for leakages from connections

and ensure that all components remain firmly fixed to their supports.

Check inlet line for properly tightened fittings and make sure it is free of restrictions and air leaks.
Be certain to fill the motor housing with clean hydraulic fluid prior to start up.
Fill the housing by pouring filtered oil into the upper case drain port.
Excess air has to be bled from the high pressure lines .
PRESSURE LINE
SAI recommend the use of high quality flexible or rigid pressure pipelines. Follow pipe manufacturer's recommendations on appropriate sizes for different flow speed ,pressures and resistances. To minimise the effects of oil compressibility, pipelines should be kept to a minimum diameter and maximum rigidity.
Once charge pressure has been established, increase speed to normal operating RPM.
WARNING
The following procedure may require the vehicle/ machine to be disabled (wheels raised off the ground, work function disconnected, etc.) while performing the procedure in order to prevent injury to the technician and bystanders. Take necessary safety precautions before moving the vehicle/ machine.

Caution
Inadequate charge pressure will affect the operator's ability to control the machine.

Fluid and Filter Maintenance

To ensure optimum service life of Series BD products, regular maintenance of the fluid and filter must be performed.
Contaminated fluid is the main cause of unit failure. Care should be taken to maintain fluid cleanliness while performing any service procedure.
It is recommended that the fluid and filter be changed per the vehicle/machine manufacturer's recommendations or at the following intervals:
First change
500 operating hours after start up
second and subsequent changes
every **2000** operating hours or once a year.
This recommendation applies for the most applications. High temperatures and pressures will result in accelerated fluid aging and an earlier fluid change may be required. At lower fluid loads longer change intervals are possible. Therefore we suggest to check the fluid with the manufacturer for suitability. This should be done at latest half way between fluid changes.
It may be necessary to change the fluid more frequently than the above intervals if the fluid becomes contaminated with foreign matter (dirt, water, grease, etc.) or if the fluid has been subjected to temperature levels greater than the recommended maximum. Never reuse fluid.
The filter should be changed whenever the fluid is changed or whenever the filter indicator shows that it is necessary to change the filter.

HYDRAULIC FLUIDS
For the choice of hydraulic fluid SAI recommend the use of high quality mineral -based hydraulic oil, containing anti-wear, anti-foaming,anti-oxidation and extreme pressure additives.

Allowable oil temperature range:- 20 to +80°C
Operating viscosity range: optimal 40 cSt to 60cSt. Choice of hydraulic oil should be made so that the viscosity is within the given range at its normal operating temperature. For details of other fluid refer technical catalogue.

FILTRATION
SAI recommend use of max. 25 micron filters (preferable 10 microns). Clean oil and therefore efficient filters are essential for the correct functioning of all the components in the hydraulic system. The efficiency of the filters is impaired by the gradual accumulation of particles intercepted and filters should there be regularly inspected.
Special attention is required when the hydraulic system is first put into operation or when any of the components are replaced or have become worn through use. The relative efficiency of a filter may be measured, for example, by taking regular reading of the pressure drop across the filter.
Follow filter manufacturer's recommendations for filter element lifetimes and cleaning or substitution cycles.

Troubleshooting

This section suggests possible explanations if certain undesirable system conditions are observed.

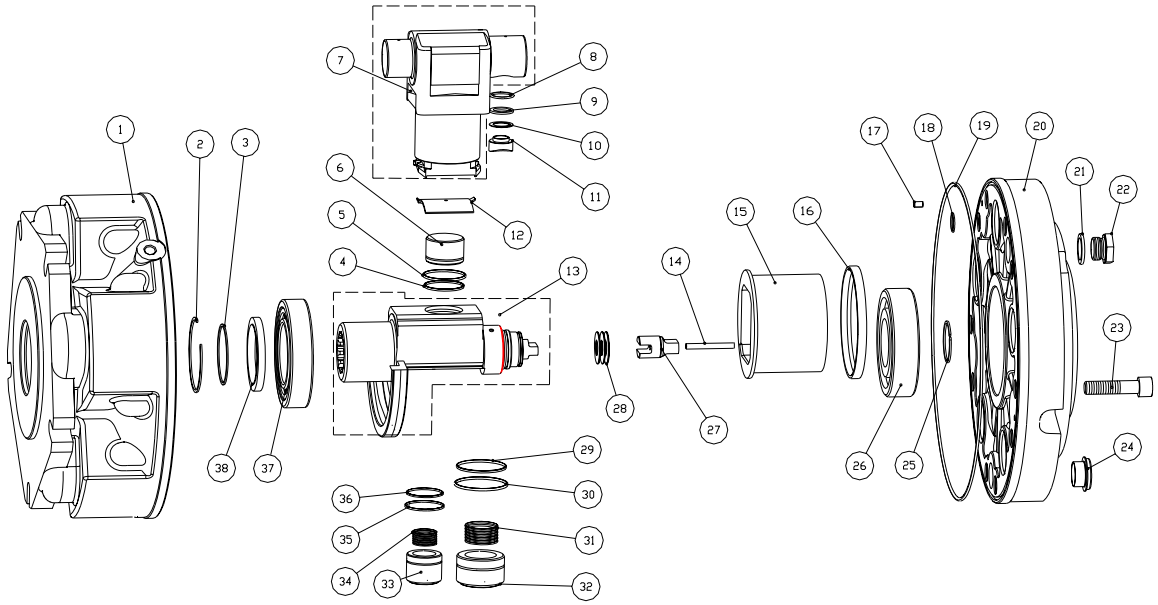
System Operating Hot	**Oil viscosity too low**
	Inadequate cooling system
Displ.Change Operates in One Direction Only	**Check pilor pressure and drain**
Displ. Will not change in Either Direction	**No Pilot Pressure**
Improper Motor Output Speed	**Speed shifting not operating**
Excessive Noise and/or Vibration	**Air in the circuit**
	Mechanical vibration
	Misallignement
System Response is Sluggish	**Low Pilot Pressure**

Exploded View and Parts List

DISPLACEMENT./ CILINDRATA	PISTON+CYL.SET/ ACCOPPIAMENTO POS. 7		PISTON/ PISTONE POS. 6		PISTON/ PISTONE POS.32		PISTON/ PISTONE POS.33		SHAFT STROKE/ CORSA ALBERO POS.13	
BD1										
	CODE	BORE	CODE	DIA	CODE	DIA	CODE	DIA	CODE	STROKE
100-25	0151003186	(28)	0151113008	25 H.18	0151113008	29 H.18	0151100008	32 H.18	0151140294	32
250-60	0151001186	(44)	0151112008	25 H.18	0151113008	29 H.18	0151100008	32 H.18	0151140294	32
175-45	0151002186	(37)	0151134008	29 H.19	0151108008	32 H.24,5	0151132008	25 H.24,5	0151140294	32
250-120	0151001186	(44)	0151112008	25 H.18	0151113008	29 H.18	0151105008	32 H.22	0151140294	32
200-100	0151001186	(44)	0151117008	25 H.21	0151116008	29 H.21	0151107008	32 H.20,5	0151140294	32
BD2										
250-65	0152110186	(40)	0152122008	(35) H.22,5	0152119008	(38) H.24,5	0152120008	(28) H.24,5	0152128294	40

250-125	0152110186	(40)	0152123008	(35) H.27,5	0152119008	(38) H.24,5	0152120008	(28) H.24,5	0152128294	40
350-125	0152105186	(47)	0152121008	(35) H.24,5	0152119008	(38) H.24,5	0152120008	(28) H.24,5	0152128294	40
350-150	0152105186	(47)	0152124008	(35) H.26	0152119008	(38) H.24,5	0152120008	(28) H.24,5	0152128294	40
350-175	0152105186	(47)	0152123008	(35) H.27,5	0152119008	(38) H.24,5	0152120008	(28) H.24,5	0152128294	40
500-125	0152102186	(56)	0152122008	(35) H.22,5	0152119008	(38) H.24,5	0152120008	(28) H.24,5	0152128294	40
500-175	0152104186	(56)	0152121008	(35) H.24,5	0152119008	(38) H.24,5	0152120008	(28) H.24,5	0152128294	40
500-250	0152104186	(56)	0152123008	(35) H.27,5	0152119008	(38) H.24,5	0152120008	(28) H.24,5	0152128294	40
BD5										
1900-500	0156182186	82	0156115008	71	0156119008	58			0156120294	70
1000-250										
1500-400										

BD1 & BD2

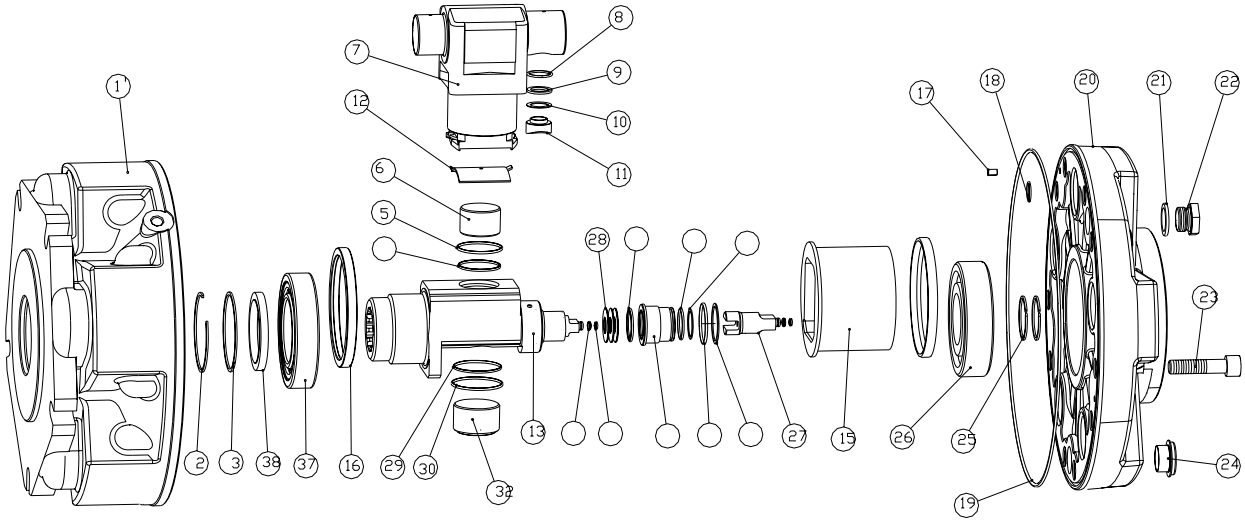


MOTOR PARTS

		BD1	BD2	BD5
Pos.38	Shaft seal	001002066	001002032	001002036
Pos.37	Bearing	0010007150	0010007015	0010007025
Pos.36	Slipper	0010038156	0010038153	
Pos.35	Or	0010012027	0010012240	
Pos.34	Spring ring	0010014043	0010014040	
Pos.33	Pilot piston	See table above	See table above	
Pos.32	Pilot piston	See table above	See table above	See table above
Pos.31	Spring Ring	0010014042	0010014041	
Pos.30	Or	0010012240	0010012258	0010012376
Pos.29	Slipper	0010038157	0010038155	0010038164

Pos.28	Cup Spring	0010014039	0010014039	0010014036
Pos.27	Drive Pin	0152130109	0152120109	0156120109
Pos.26	Bearing	0010007165	0010007170	0010007025
Pos.25	Seeger	0010001103	0010001103	0010038136
Pos.24	Plastic Plug	0010023016	0010023015	0010023087
Pos.23	Bolt	0010025484	0010025342	0010025299
Pos.22	Plug	0010023051	0010023047	0010023047
Pos.21	Washer	0010018094	0010018095	0010018095
Pos.20	Motor cover	0148107002	0152140102	0156150002
Pos.19	Or	0010012043	0010012277	0010012079
Pos.18	Or	0010012237	0010012287	0010012253
Pos.17	Pin	0010020007	0010020048	0010020026
Pos.16	Retaining ring	0151100211	0152110211	0156100211
Pos. 15	Mobile bush	0151115010	0152115010	0156100010
Pos.14	Connecting drive pin	0153130109	0153130109	0156120109
Pos.13	Shaft SubAss.y	See table above	See table above	See table above
Pos.12	Sliding Pad	0151100118	0152116118	0156100118
Pos.11	Trunnion Seal	0148002108	0150002108	0185100108
Pos.10	Antiextrusion ring	0010301136	0010301137	0010301131
Pos.9	Slipper	0010001121	0010001115	0010001138
Pos.8	Oring	0010012065	0010012283	0010012106
Pos.7	Cyl./Piston Subass.Y	See table above	See table above	See table above
Pos.6	Pilot Piston	See table above	See table above	See table above
Pos.5	Or	0010012237	0010012239	0010012376
Pos.4	Slipper	0010037002	0010038154	0010038065
Pos.3	Reinf.ring	Opt.	Opt.	0010301125
Pos.2	Ret.circlip	0010001066	0010001061	0010001089
Pos.1	Motor body	0148113001	0150112001	0156128001

BD5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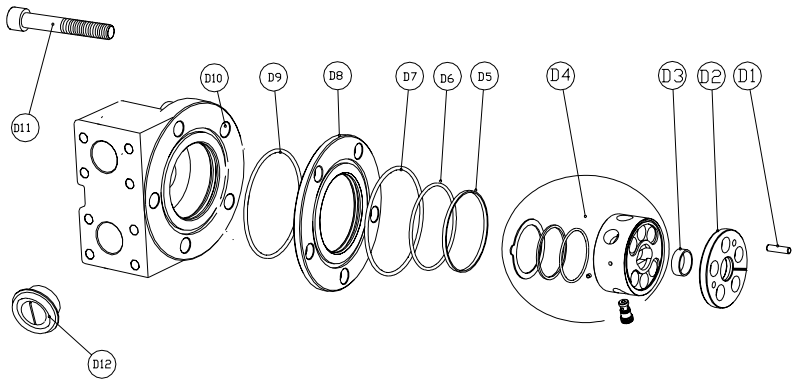
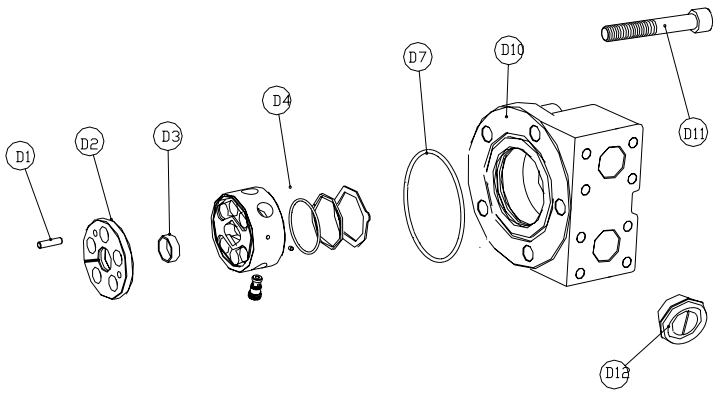
D40,D47 DISTRIBUTOR SUB-ASSEMBLY PREMONTAGGIO DISTRIBUTORE



D40,D47 D90 DISTRIBUTOR SUB-ASSEMBLY PREMONTAGGIO DISTRIBUTORE

POS.	DESCRIPTION	QTY	CODE	POS	DESCRIPTION	QTY	CODE
	DESCRIZIONE	**QUANTITA'**	**CODICE**		**DESCRIZIONE**	**QUANTITA'**	**CODICE**
D1	LOCATING PINS **D90 LOCATING PINS** SPINE	2	0010020007 **0010020026**	D7	O-RING SEAL **D90 O-RING SEAL** GUARNIZIONE OR	1	0 010 012 043 **0010012205**
D2	BRONZE DISC **D90 BRONZE DISC** DISCO BRONZO	1	K 140 000 250 **K190130250**	D8	INTERMEDIATE FLANGE FLANGIA INTERMEDIA	1	0 140 002 250
D3	BUSH **D90 BUSH** BOCCOLA	1	0 140 000 012 **0190130212**	D9	O-RING SEAL GUARNIZIONE OR	1	0 010 012 043
D4	ROTARY VALVE SUBASS.Y **D90 ROTARY VALVE SUBASS.Y** PREMONTAGGIO ROTANTE	1	0 140 052 087 **0190056087**	D10	DISTRIB COVER **D90 DISTRIB. COVER** COP.DIST.D47	1	0140047803 **019000083**
D5	PLASTIC SEAL GUARNIZIONE ANELLO	1	0 010 038 054		DISTRIB COVER COP.DIST.D40	1	0 140 135 003
D6	O-RING SEAL GUARNIZIONE OR	1	0 010 012 040	D11	SCREW **D90 SCREW** VITE M12.85	5	0 010 025 475 **0010025442**
				D12	PLASTIC PLUG	2	0010023069 **0010023087**

D90 DISTRIBUTOR SUB-ASSEMBLY PREMONTAGGIO DISTRIBUTORE



Inspections and Adjustments

This section offers instruction on how to perform inspections motor components.

Strip-down procedure

1. SCREW OFF THE BOLTS OF DISRIBUTOR COVER.

2. LIFT UP DISTRIBUTOR COVER AXIALLY TO THE MOTOR COVER.

3. LIFT UP AXIALLY THE ROTARY DRIVE.

4. TAKE OFF INTERMEDIATE FLANGE

6 TAKEOFF BRONZE DISC .

7 TAKE OFF THE CROSS DRIVE PIN AND THE CONNECTING ROD WITHOUT SCRATCHING IT.

8 SCREW OFF THE BOLTS AND LIFT UP THE MOTOR COVER.

9 TAKE OFF THE 12 CUP SPRINGS.

10 TAKE OFF THE RETAINING RING AND THEN PISTON+CYLINDER SETS.

11 LIFT UP THE CRANKSHAFT FROM THE BEARING SEAT IN THE MOTOR BODY

12 LIFT UP THE INNNER RING OF THE BEARING FROM THE BEARING SEAT IN THE MOTOR COVER.

13 TAKE OFF FROM ITS SEAT THE CIRCLIP FIXING THE SMALL PISTON OF THE SHAFT SUBASSEMBLY AND THEN TAKE OFF THE PISTON ITS.

Components

Sub-assemblies

SHAFT SUBASSEMBLY

MOTOR BODY

MOTOR COVER

PIST& CYL.SET