



INDIAN RAILWAYS

TRACK MACHINES DIGEST

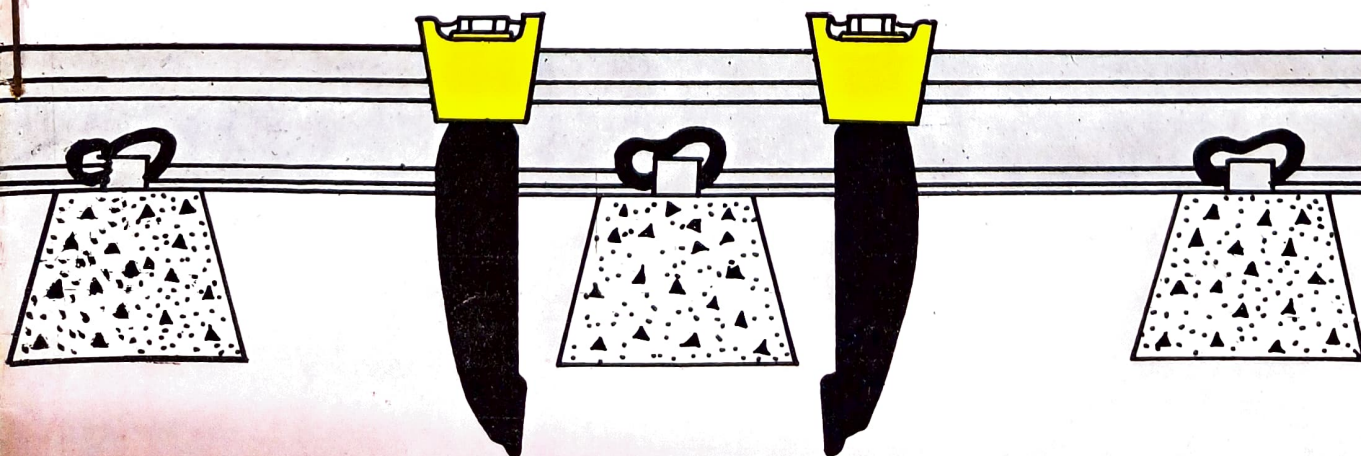
भारतीय रेल, रेलपथ मशीन डायजेस्ट

YEAR-4

ISSUE-12

QUARTERLY

DEC.-1996



OUT PUT OF DYNAMIC TRACK STABILISER IN KM. DURING 1996-97

RLY.	NO OF MACHINE	OUT PUT IN KM	
		95-96	96-97 (UPTO SEPT.)
CR	1	518	269
ER	1	480	283
NR	2	1006	495
SR	1	234	179
SCR	2	333	463
SER	1	66	89
WR	1	96	141
TOTAL	9	2733	1919

TARGET 1M/C = 110 KM/MONTH

OUT PUT OF BCM - 76 POINTS & CROSSING IN KM. DURING 1996-97

RLY.	NO OF MACHINE	OUT PUT IN KMS	
		95-96	96-97
CR	1	24.8	4.4
NR	1	56.1	14.8
TOTAL	2	80.9	19.2

TARGET 1 M/C = 7 km or 12 T.O./ per Month

OUT PUT OF FRM-80 FOR SHOULDER BALLAST CLEANER IN KM. DURING 1996-97

RLY.	NO OF MACHINE	OUT PUT IN KM	
		95-96	96-97 (UPTO SEPT.)
CR	2	52.9	36.9
ER	1	201.6	30.8
NR	2	44.3	98.7
SER	1	81.0	53.9
TOTAL	6	379.8	220.3

OUT PUT OF RAIL GRINDING MACHINE RECTIFIED KM. DURING 1996-97

RLY.	NO OF MACHINE	OUT PUT IN KM	
		95-96	96-97 (UPTO SEPT.)
SER	1	NIL	NIL

TARGET 1M/C = 300 KM : ASS/MONTH

OUT PUT OF TRACK RELAYING TRAIN IN KM. DURING 1996-97

RLY.	NO OF MACHINE	OUT PUT IN KM	
		95-96	96-97 (UPTO SEPT.)
CR	1	-	-
NR	1	100.5	28.5
SCR	-	-28.5	-
SER	1	54.3	34.3
TOTAL	3	183.3	62.8

OUT PUT OF T+28 DURING 1996-97

RLY.	NO OF SETS (per Sets = 2 Machine)	OUT PUT IN KM	
		95-96	96-97 (UPTO SEPT.)
CR	1	87	44
ER	1	75	15
NR	1	92	27
SR	1	53	30
SCR	2	203	127
SER	1	70	40
WR	1	NIL	4
TOTAL	8 Sets	580	287

TARGET 1 M/C/MONTH = 12.T.O.

OUT PUT OF TAMPING MACHINES IN KM. DURING 1996 - 97

RLY.	UT	MACNINE DETAILS			TOTAL NO. OF MACHINE	OUT PUT IN KMs	
		UNO	DUO	CSM		95-96	96-97 <i>upto Sept.</i>
CR	8	-	1	8	17	6591	3350
ER	1	1	3	6	11	4700	2368
NR	1	2	5	6	14	7120	3009
NER	-	3	1MG	2	6	860	568
NFR	2	-	1	1	4	404	419
SR	3	-	2BG	6	12	4314	2162
			1MG				
SCR	2	-	4	6	12	4629	2284
SER	2	1	3	8	14	4943	2691
WR	4	1	1MG	8	15	5350	2777
			1BG				
TOTAL	23	8	20BG 3MG	51	105	38911	19628

<u>TARGET</u>	UT	=	31 KM PER MACHINE / MONTH
	UNO	=	56 KM PER MACHINE / MONTH
	DUO	=	56 KM PER MACHINE / MONTH
	UNO	=	110 KM PER MACHINE / MONTH

RELAYING OF TRACK BY PQRS IN KM. DURING 1996-97

RLY.	NO OF MACHINE	OUT PUT IN KM	
		95-96	96-97 <i>upto Sept.</i>
CR	8	93.6	43.7
ER	12	93.1	44.1
NR	4	98.7	51.8
NER	6	16.0	NIL
SR	15	120.2	250.7
SCR	12	159.9	42.5
SER	16	234.7	62.7
WR	8	77.8	43.2
TOTAL	81	894	538.7

TARGET
9 TONNE CAPACITY = 5.0 KM/MONTH/MACHINE

OUT PUT OF BALLAST CLEANING MACHINE R.M.80 IN KM. DURING 1996-97

RLY.	NO OF MACHINE	OUT PUT IN KM	
		95-96	96-97 <i>upto Sept.</i>
CR	2	79.8	20.7
ER	2	39.4	14.6
NR	2	80.1	39.9
SR	1	50.3	10.3
SCR	2	54.4	18.0
SER	2	46.3	8.8
WR	1	64.7	34.2
TOTAL	12	415.0	146.5

TARGET 1M/C = 12 KM/ MONTH

OUT PUT OF BALLAST REGULATOR IN KM. DURING 1996-97

RLY.	NO OF MACHINE	OUT PUT IN KM	
		95-96	96-97 <i>upto Sept.</i>
CR	4	4689	1983
ER	3	2330	1176
NR	3	3038	1221
NFR	1	369	477
SR	2	1297	680
SCR	3	3016	1714
SER	3	631	632
WR	3	2041	534
TOTAL	22	17411	8417

TARGET
1M/C = 100 KM/ MONTH

OUT PUT OF POINTS & CROSSING TAMPER 08.275 IN TO DURING 1996-97

RLY.	NO OF MACHINE	OUT PUT IN KM	
		95-96	96-97 <i>upto Sept.</i>
CR	4	3923	2110
ER	3	1723	808
NR	4	2289	1053
SR	3	1182	653
SCR	3	1854	992
SER	3	959	594
WR	3	1897	935
TOTAL	23	13827	7145

TARGET 1M/C = T.O / MONTH

HYDRAULIC SEALS

MANOHAR SINGH
VICE PRINCIPAL
IRTMTC - ALD

The Hydraulic seals are divided in two categories i.e. static and dynamic seals.

- | | | |
|---------|---|-------------------------------------|
| Static | - | O-Rings. |
| Dynamic | - | Lipseals, Scrappers, & O-rings etc. |

A seal having effective performance has become challenge of the day due to high working pressure and fast cylinder speed. Different duty cycle cylinder require variety of seals as per application. The choice of seal is guided by surface finish, side loads, temperature and pressure. A seal may be of a very good quality but its service life does not depend merely on seal material, but is greatly influenced by surface finish and method of installation.

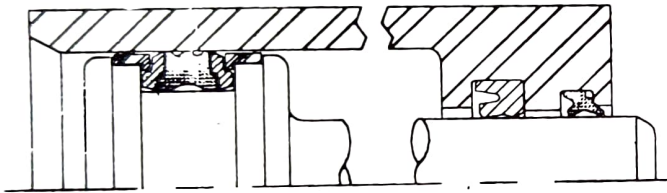


Figure - 1

SEALING SYSTEMS :

Light duty systems : For system pressures upto 150. This light duty system can be for heavy duty equipment cylinders where duty, Cycle is less and operating temperature (30 C -100 C) and low speed (0.5m/Sec. or less). Life requirement is less and cylinder lengths are short.

Fig. (1) Shows the L-Section of cylinder showing the seals in position.

Material used for Rod seals is polyurethane and that for piston seals is nitrile both these materials are injection mouldable, can be installed easily and mass production

is possible with high quality. To prevent extraction of piston seals into clearance, built in back up rings are used, to further improve the piston seal performance, hard plastic bearing elements are used, to further improve the piston seal performance, hard plastic bearing elements are used. Wiper is also an important element for rod sealing to keep the majority of contamination out of the system. Material used is mostly polyurethane being ductile.

MEDIUM DUTY SYSTEM :

This system is suitable for pressure range upto 250 and velocities upto 0.50 M/Sec. Due to high pressure more extrusion resistant material is reqd. to withstand increased side load. For this sealing material should be such, that have long life and involve minimum maintenance, so durable sealing system is needed and nitrile seals, Cannot be used for high pressures and velocities. In this system mostly PTFE based seals are used as shown in the **Fig 2**.

To improve the extrusion, fillers and reinforcements such carbon fillers, bronze or glass are added to PTFE. The advantage of this type of seals are as below.

1. High operating speed upto 15M/Sec.
2. Minimum friction heat build up or any stick-slip effect.
3. Persist higher pressure without extrusion.
4. Can withstand high side loading.
5. Can have more clearance gap, by composite bearing, metal to metal contact is avoided.
6. Can have more cylinder life.
7. Longer life of seals results in reduced down time and more production.
8. Maintenance is minimised.

This type of sealing system is provided by Plasser Indian

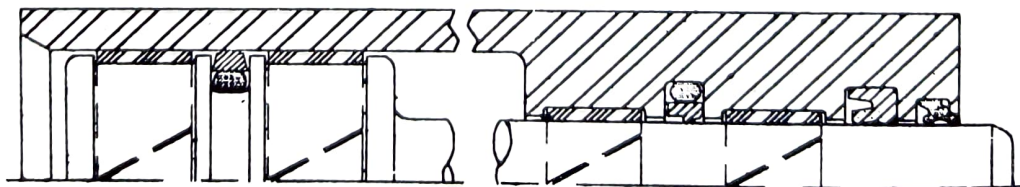


Figure - 2

on modern TT machines for tamping unit up and down cylinder, and squeezing cylinders.

HEAVYDUTY SYSTEMS :

In these system operating pressure exceeds 300 bar with spikes beyond 500 bar, while velocities usually. 5m/Sec, the operating temprature range is 30°C to 100°C. This special sealing system can with stand heavy side loads and dirty operating conditions. The installation of seals is as fig. 3.

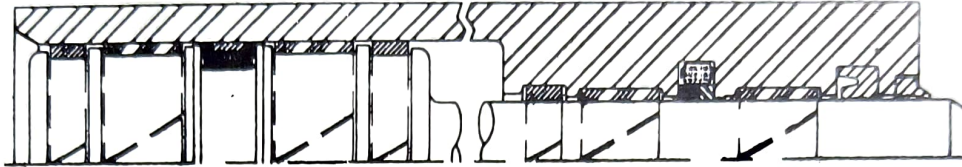


Figure - 3

DEVELOPMENT OF PTFE SEALS :

PTFE - Polyterrafluorethylene :

1. **History :** In April 1938 during tests with the refrigerant FREON(R) Dr. Roy J. Plunkett from the Du Pont laboratory in Jackson, New Jersey, discovered a white wax-type polymer which, after further detailed testing at a later undisclosed date, exhibited extraordinary material porpteries.
2. **Basic Properties :** The material did not exhibit any change whatsoever when subjected to practically all known chemicals and its surface was so smooth that hardly any forign substance remained. Moisture and solar radiation (Sunshine) caused neither volumetric change nor disintegration and brittleness. The Crystalline change associated with the melting point of the material starts at 327°C without there being any typical thermo-plastic liquefaction.
3. **Processing :** For the above reasons, process technology similar to powder metallurgy is utilized. PTFE powder is compressed into blocks or rods, sintered and then mechanically machined to the required shapes. Based on experience over the last 30 years, the material industry has developed PTFE type that for certain defined applications can also be thermoplastically processed.
4. **Application :** The possibility of compounding i.e. matching physical properties to specific applications through the addition of fillers, is an important factor for the use of PTFE in the manufacture

of seals and guide elements.

In spite of its remarkable properties, pure unmixed PTFE is limited use for applications where high mechanical loading is required due to its tendency towards cold-chamber (Creep).

5.

Fillers : The influence of filler materials is particularly illustrated by :

- improvement in the flow strength
- reduction of friction and wear

- increase in strength
- increase in thermal shape stability
- increase in hardness.

The most important standard fillers are :

- Glass fibres
- Carbon/Graphite.
- Pigments
- Bronze
- Molybdenum
- disulphide(MoS2)
- Polymers.

Selection of fillers is determined by the following application criteria :

5.1 Glass fibres :

Improve creep strength over a wide temperature range and increase the chemical stability (with the exception of strong alkaline solutions and hydrofluoric acid).

5.2 Bronze :

Copper/tin alloys mixed with PTFE porduce significant improvement in the creep strength and thermal conductivity.

5.3 Carbon/Graphite :

Creep strength, hardness and thermal conductivity are increased. There is also a distinct improvement in wear resistance. Machining of carbon-filled compounds has much less tool wear and is therefore a favoured method of producing parts to close tolerances : Graphite the crystalline form of high purity carbon, is chemically inert, and can resist to high pressures.

5.4 MoS₂ :

Improved hardness and rigidity and less friction. Only used in small proportions and in conjunction with other fillers.

5.5 Polymers :

Polymer fillers that are resistant to high temperatures improve friction in contact with soft metals.

5.6 Pigments :

Pigments are added as colouring agents and have practically no effect on the material properties.

6. **Special Characteristics of PTFE :**

6.1 At low temperatures :

Even at -269°C (boiling point of Helium) PTFE still has residual extensibility, so that it can also be used under extreme conditions, e.g. in space. The temperature-dependent elongation or shrinking that occurs as with other plastics is reduced.

6.2 At high temperatures :

PTFE has exceptional thermal resistance, so that it can be used at temperatures up to 260°C (dependent on working conditions). Fillers have no influence on the PTFE's own thermal resistance. Most of the fillers are stable up to 400°C, so that they do not restrict high temperature use.

POLON^(R) PTFE STANDARD COMPOUNDS :

Ref.	Compound	Colour	Mainly used for	Characteristics.
W5140	modif. PTFE + 40% bronze	bronze	Glide rings hydr. guide rings Black - uprings	High creep resistance High wear resistance
W5160	modif. PTFE + 60% bronze	bronze	Guide rings Back-up rings	best creep resistance (among the filled compounds)
W5038	pure PTFE + 25% carbon	black	Glide rings pneumatic Guide rings Back-up rings	best chemical resistance, very high wear resistance & high creep resistance.
W5117	pure PTFE + 23% carbon + 2% graphite	black	Glide rings Back-up rings	very high chemical resistance best wear resistance & high creep resistance.
W5115	modif. PTFE + 60% glass-fibre	dark green	Glide rings Back-up rings Guide rings	very good chemical resistance electr. attributes like pure PTFE high creep resistance.
W5036	pure PTFE	white	Glide rings Back-up rings Spring loaded seals.	suitable for application in the food sector
W5112	modif. PTFE	dark green	Glide rings Back-up rings Spring loaded seals.	improved wear and creep resistance compared to W5036
W5119	pure PTFE + 15% graphite	black	Spring loaded seals.	
W5010	pure PTFE + 15% carbon	black	Spring loaded seals.	

Any component weighs 23 KG or more to avoid personal injury, use a hoist or get assistance to lift the component.

- 1) The hardness values are average values measured on a standard specimen of 6mm thickness acc. to DIN 53505 Measuring of finished parts can have different results.
- 2) The minus temperatures have to be considered as a guideline due to the fact that the function at cold temperature depends on the seal design,

the operating

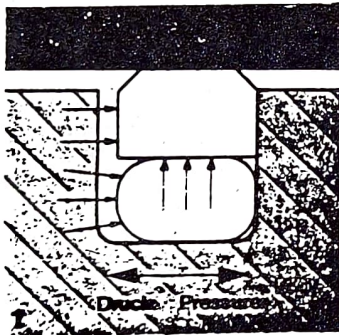
Conditions and the condition of adjoining metal parts. The plus temperatures may be exceeded, but the operating life is shortened correspondingly. If aggressive media are used, the stated temperature resistance can be considerably reduced.

SPECIAL SEALS ON TT/MACHINES

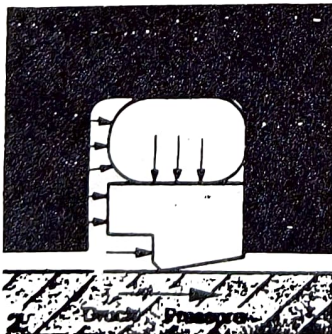
TURCON GLYD RING AND TURCON STEPSEAL :

These seals are used to seal pistons and rods of working cylinders. The latest development in piston and rod end seals is a turcon Glid Ring & step seal K can have reliable operation for all high pressure and low pressure systems.

The Turcon Glyd-Ring is a double acting and Turcon step seal-K is a single-acting sealing element. These seals are installed together with O-ring.



Turcon-Glyd-Ring double-acting
Figure - 4.



Turcon-Stepseal Single-acting
Figure - 5

The sealing effect is created by means of the interference fit of the Turcon ring and O-ring forces. These are

self acting seals since the sealing forces depend on system pressure. The result is increase in tightness as the pressure increases.

ADVANTAGES :

- Excellent anti friction characteristics
- No stick - slip effect during start up
- No adhesion effect.
- High degree of resistance to abrasion
- Long service life.
- Very good dynamic and static sealing characteristics.
- Can be used in the majority of operating media with or without lubrication characteristics.
- Simple groove configuration
- Single piece piston and cyld. head possible.

FIELD OF APPLICATION :

Turcon Glyd-Ring and Turcon-Stepseal are used as sealing elements for piston and Rods with reciprocating movement Fig.-6. It is almost a leak proof seal.

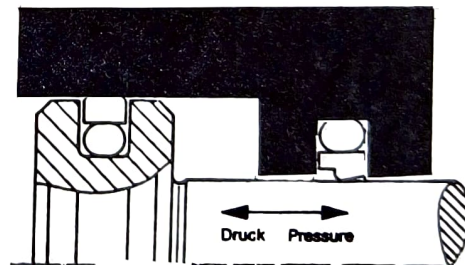


Figure - 6

WEAR RINGS :

Wear rings correctly guide the piston and rod of a cylinder and also take transverse forces which occur. No metal-to-metal contact will occur, between sliding parts. Nonmetallic wear rings are much better than metallic.

Advantages of non metallic wear rings :

- High load bearing capacity.
- Long service life as it is wear resistant.
- Good thermal stability
- Damping of mechanical vibrations.
- Good wiping effect, embedding of foreign particles.
- Free selection of material no need of selection of guiding properties.
- No hydrodynamic problems in the sealing.
- Simple, continuous grooves easy to assemble.
- Low servicing cost.
- Eliminate drag pressure built up.

Wear - rings have a rectangular cross section. They are made from tubular material and cut obliquely. The wear rings are available with the gap (dimension Z). These are also made from strips.

INSTALLATION OF SPECIAL SEALS PTFE MATERIAL i.e. TURCON GLYD RINGS STEP SEAL AND WEAR RINGS :

Performance of special seals also depend upon their method of installation, Wrong procedure can spoil the costly seals. It should be done with special installation tools, these allow the seal to be installed with ease and safety. Knowledge of proper installation technique and skill improves over all quality and performance by preventing the seal damage.

SURFACE FINISH :

Grinding as final machining process for dynamic sealing surfaces is not sufficient. These surfaces have to be polished after wards.

Combining modern seal technology with proper installation techniques and a high quality surface finish, results in hydraulic system capable of meeting the requirement of today's and tomorrow's specialised machinery. Installation tools should be from soft material i.e. soft plastics such as Nylon or delrin, to avoid damage to seals. Tools corners should be rounded and free from burs to avoid nicking the seals. Sharp metal tools to be avoided. In order to help seals slide into place, all gland hardware should be cleaned and lubricated with light oil prior to seal installation, to protect seals from ultraviolet

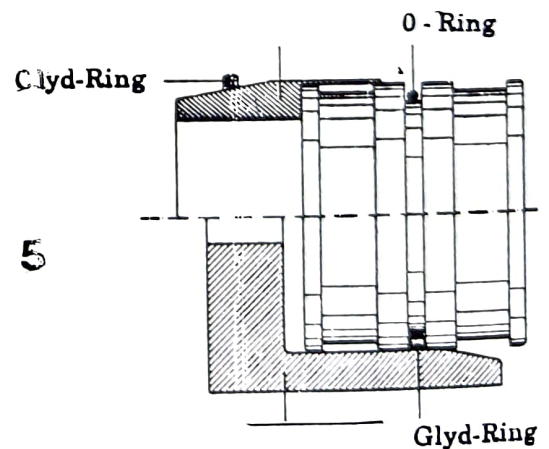
light, ozone heat, humidity, and weathering, surplus seals should be stored in original container special boxes or until necessary. An improperly stored seal can degrade before installation. Special attention should be paid for seal asymmetry. A rod seal installed backward can be impossible to remove. After installation seals should be inspected for scratches and nicks. damaged seal should be cut, removed and discarded.

ASSEMBLY INSTRUCTIONS :

- It is essential cyld. piston, Rod and piston entry end should be chamfered.
- Sharp edges should be deburd, filleted or chamfered. the crest of the threads to be covered.
- Any dust dirt, splinters of other foreign particles to be removed carefully.
- Do-not use tools with sharp edges.
- Before assembly, the piston rod and seals must be oiled.
- These seals can expand upon heating 80-120°C in oil or water and regain original size in calibrating ring after colling.

External seals (piston seals) insert O-ring in the groove. A conical sleeve can also be used for this purpose.

Push the heated Turcon rig over conical sleeve to expand it as show in Fig. 7.



The expanded ring snaps into position in the groove but protrudes slightly out words. It is brought to proper size and shape with a calib rating sleeve as in Fig. 7.

The inside diameter of the calibrating ring should be equal to cyl. diameter.

In many cases Turcon rings can be fitted without these tools, with the help of plastic tape. The ring is then resized after passing the piston with ring through the chamfered end of the cylinder.

INTERNAL SEALS :

- Insert O-ring in the groove.

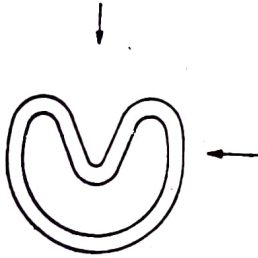


Figure - 8



Figure - 9

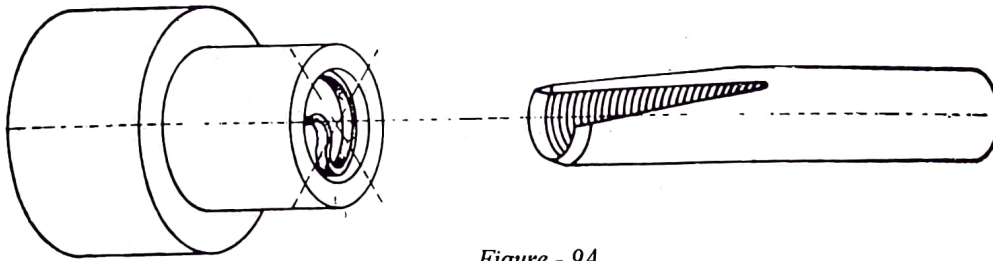
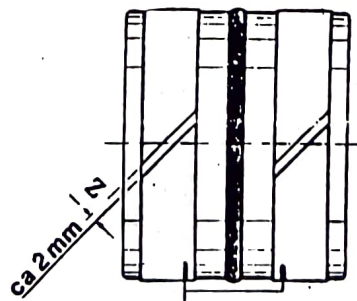


Figure - 9A

The wear - rings are fitted loosely into recessed grooves on the piston. The number of wear-rings will depend upon the radial forces and permissible surface pressure on the wear-ring material in addition to the length of

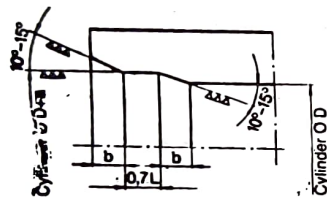
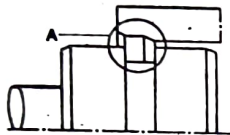
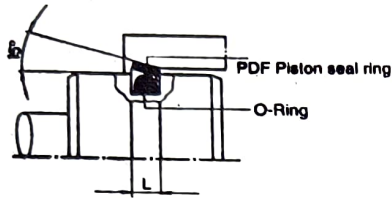
stroke, the diameter and other factors dependent up on design and installation. After installing the grooves to be staggered as shown in Fig. 10.



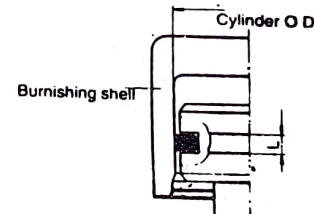
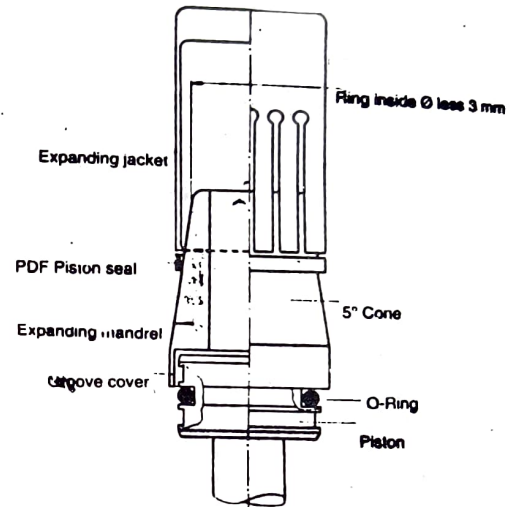
Wear-rings

Figure - 10

Dimensional Data Glyd Ring T. for piston, ring for Piston and Gland. Stepseal IC for Gland bush and wear ring.



Zyl. Ø D	a	b
- 45	0,8	2,4
50 - 175	1,0	3,0
180 - 230	1,5	4,5



AVOID PROLONGED AND REPEATED SKIN CONTACT WITH USED ENGINE OIL, SUCH CONTACT MAY CAUSE SERIOUS SKIN DISORDEE AND OTHER SERIOUS BODILY INJURY. AVOID EXCESSIVE CONTACT - WASH THOROUGHLY AFTER CONTACT.

DO-NOT OPERATE A DIESEL ENGINE WHERE THERE ARE OR CAN BE COMBUSTIBLE VAPOURS THIS CAN CAUSE ENGINE ACCELETATION AND OVER-SPEEDING, WHICH CAN RESULT IN FIRE EXPLOSION.

Turcon® Glyd Ring® T Dimensional Data

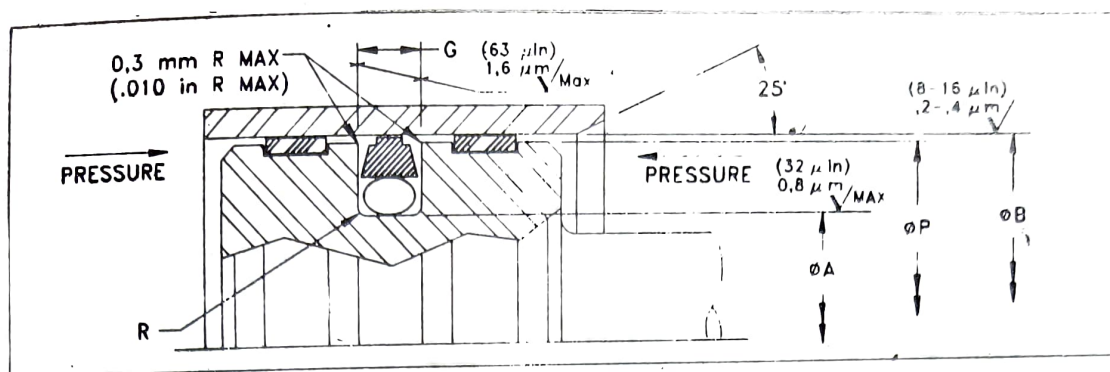


Table 1 Turcon® Glyd Ring® T Metric Ordering Information (Dimensions in mm)

Bore Dia.	Groove Dia.	Groove Widthth	Maximum Piston Diameter P			Radius Max	O-Ring Nitrile	Turcon® Glyd Ring® T Turcon® T46
			0-100 Bar	100-200 Bar	200-320 Bar			Part No.
B H9	AH9	G+0,2				R	DashNo.	
12,0	7,1	2,2	11,04	11,44	11,64	0,4	011	PT0000120-T46NA
14,0	9,1	2,2	13,04	13,44	13,64	0,4	012	PT0000140-T46NA
15,0	7,5	3,2	13,84	14,24	14,64	0,6	109	PT0100150-T46NA
16,0	8,5	3,2	14,84	15,24	15,64	0,6	109	PT0100160-T46NA
18,0	10,5	3,2	16,84	17,24	17,64	0,6	111	PT0100180-T46NA
20,0	12,5	3,2	18,85	19,25	19,65	0,6	112	PT0100200-T46NA
22,0	14,5	3,2	20,85	21,25	21,65	0,6	113	PT0100220-T46NA
25,0	17,5	3,2	23,85	24,25	24,65	0,6	115	PT0100250-T46NA
28,0	20,5	3,2	26,85	27,25	27,65	0,6	117	PT0100280-T46NA
30,0	22,5	3,2	28,85	29,25	29,65	0,6	118	PT0100300-T46NA
32,0	24,5	3,2	30,86	31,26	31,66	0,6	119	PT0100320-T46NA
35,0	27,5	3,2	33,86	34,26	34,66	0,6	121	PT0100350-T46NA
40,0	29,0	4,2	38,86	39,26	39,66	0,8	216	PT0200400-T46NA
42,0	31,0	4,2	40,86	41,26	41,66	0,8	217	PT0200420-T46NA
45,0	34,0	4,2	43,86	44,26	44,66	0,8	219	PT0200450-T46NA
48,0	37,0	4,2	46,86	47,26	47,66	0,8	221	PT0200480-T46NA
50,0	39,0	4,2	48,86	49,26	49,66	0,8	222	PT0200500-T46NA
52,0	41,0	4,2	50,87	51,27	51,67	0,8	223	PT0200520-T46NA
55,0	44,0	4,2	53,87	54,27	54,67	0,8	224	PT0200550-T46NA
60,0	49,0	4,2	58,87	59,27	59,67	0,8	225	PT0200600-T46NA
63,0	52,0	4,2	61,87	62,27	62,67	0,8	226	PT0200630-T46NA
65,0	54,0	4,2	63,87	64,27	64,67	0,8	227	PT0200650-T46NA

To prevent damage to the starter, do-not engage the started motor for more then 30 seconds. Wait for two minutes between each attempt.

If Engine do-not start after 3 attempts, Check the fuel Supply system.

Table 1 Turcon® Glyd Ring® T Metric Ordering Information (Dimensions in mm)

Continued

Bore Dia.	Groove Dia.	Groove Width	Maximum Piston Diameter P			Radius Max	O-Ring Nitrile	Turcon® Glyd Ring® T Turcon® T46
B H9	AH9	G+0,2	0-100 Bar	100-200 Bar	200-320 Bar	R	Dash No.	Part No.
70,0	59,0	4,2	68,87	69,27	69,67	0,8	228	PT0200700-T46NA
75,0	64,0	4,2	73,87	74,27	74,67	0,8	230	PT0200750-T46NA
80,0	64,5	6,3	78,47	79,07	79,47	1,2	333	PT0300800-T46NA
85,0	69,5	6,3	83,49	84,09	84,49	1,2	335	PT0300850-T46NA
90,0	74,5	6,3	88,49	89,09	89,49	1,2	336	PT0300900-T46NA
95,0	79,5	6,3	93,49	94,09	94,49	1,2	338	PT0300950-T46NA
100,0	84,5	6,3	98,49	99,09	99,49	1,2	339	PT0301000-T46NA
105,0	89,5	6,3	103,49	104,09	104,49	1,2	341	PT0301050-T46NA
110,0	94,5	6,3	108,49	109,09	109,49	1,2	342	PT0301100-T46NA
115,0	99,5	6,3	113,49	114,09	114,49	1,2	344	PT0301150-T46NA
120,0	104,5	6,3	118,49	119,09	119,49	1,2	346	PT0301200-T46NA
125,0	109,5	6,3	123,50	124,10	124,50	1,2	347	PT0301250-T46NA
130,0	114,5	6,3	128,50	129,10	129,50	1,2	349	PT0301300-T46NA
135,0	114,0	8,1	133,50	134,10	134,50	1,5	425	PT0401350-T46NA
140,0	119,0	8,1	138,50	139,10	139,50	1,5	426	PT0401400-T46NA
150,0	129,0	8,1	148,50	149,10	149,50	1,5	429	PT0401500-T46NA
160,0	139,0	8,1	158,50	159,10	159,50	1,5	432	PT0401600-T46NA
170,0	149,0	8,1	168,50	169,10	169,50	1,5	435	PT0401700-T46NA
180,0	159,0	8,1	178,50	179,10	179,50	1,5	438	PT0401800-T46NA
190,0	169,0	8,1	188,52	189,12	189,52	1,5	439	PT0401900-T46NA
200,0	179,0	8,1	198,52	199,12	199,52	1,5	441	PT0402000-T46NA
210,0	189,0	8,1	208,52	209,12	209,52	1,5	442	PT0402100-T46NA
220,0	199,0	8,1	218,52	219,12	219,52	1,5	444	PT0402200-T46NA
230,0	209,0	8,1	228,52	229,12	229,52	1,5	445	PT0402300-T46NA
240,0	219,0	8,1	238,52	239,12	239,52	1,5	446	PT0402400-T46NA
250,0	229,0	8,1	248,52	249,12	249,52	1,5	447	PT0402500-T46NA
280,0	259,0	8,1	278,53	279,13	279,53	1,5	449	PT0402800-T46NA
300,0	279,0	8,1	298,53	299,13	299,53	1,5	451	PT0403000-T46NA
320,0	299,0	8,1	318,54	319,14	319,54	1,5	452	PT0403200-T46NA
350,0	325,5	8,1	348,34	349,14	349,34	1,5	454	PT0803500-T46NA
400,0	375,5	8,1	398,34	399,14	399,34	1,5	458	PT0804000-T46NA
420,0	395,5	8,1	418,36	419,16	419,36	1,5	460	PT0804200-T46NA
450,0	425,5	8,1	448,36	449,16	449,36	1,5	462	PT0804500-T46NA
480,0	455,5	8,1	478,36	479,16	479,36	1,5	464	PT0804800-T46NA
500,0	475,5	8,1	498,36	499,16	499,36	1,5	466	PT0805000-T46NA

Do-not idle the engine for more then 10 minutes, long idle can damage the engine as combustion chamber temperature drops so low, that fuel will not burn completely and will cause carbon to clog injector holes, piston rings, and valve sticking.

Turcon® Stepseal® K-R Dimensional Data

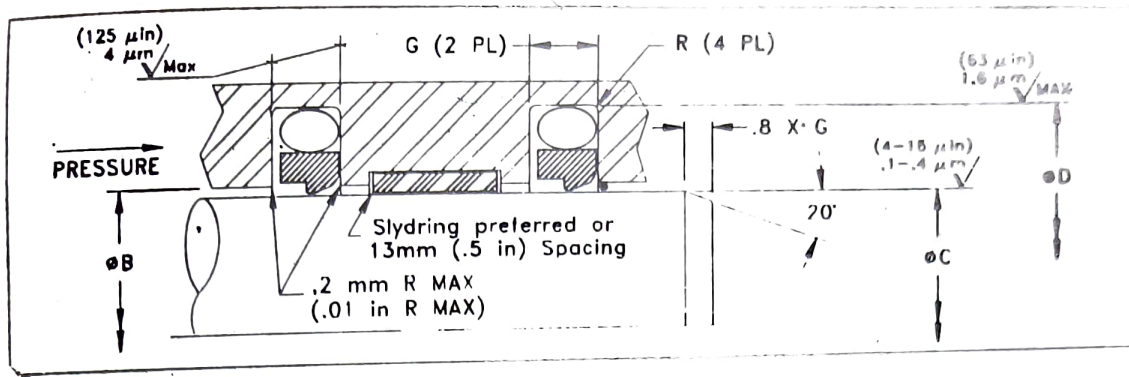


Table VII Turcon® Stepseal® K-R Metric Ordering Information (Dimensions in mm)

Bore Dia.	Groove Dia.	Groove Width	Maximum Rod Bore Diameter B			Radius Max	O-Ring Nitrile	Turcon® Stepseal® K-R Turcon® T46
C f8	D H9	G+0,2	0-100 Bar	100-200 Bar	200-300 Bar	R	Dash No.	Part No.
4	8,9	2,2	4,5	4,4	4,3	0,3	010	RS1300040-T46NA
5	9,9	2,2	5,5	5,4	5,3	0,3	011	RS1300050-T46NA
6	10,9	2,2	6,5	6,4	6,3	0,3	011	RS1300060-T46NA
7	11,9	2,2	7,5	7,4	7,3	0,3	012	RS1300070-T46NA
8	15,3	3,2	8,6	8,5	8,3	0,5	111	RS1300080-T46NA
10	17,3	3,2	10,6	10,5	10,3	0,5	113	RS1300100-T46NA
12	19,3	3,2	12,6	12,5	12,3	0,5	114	RS1300120-T46NA
14	21,3	3,2	14,6	14,5	14,3	0,5	115	RS1300140-T46NA
15	22,3	3,2	15,6	15,5	15,3	0,5	116	RS1300150-T46NA
16	23,3	3,2	16,6	16,5	16,3	0,5	116	RS1300160-T46NA
18	25,3	3,2	18,6	18,5	18,3	0,5	118	RS1300180-T46NA
20	30,7	4,2	20,7	20,5	20,4	0,7	214	RS1300200-T46NA
22	32,7	4,2	22,7	22,5	22,4	0,7	215	RS1300220-T46NA
25	35,7	4,2	25,7	25,5	25,4	0,7	217	RS1300250-T46NA
28	38,7	4,2	28,7	28,5	28,4	0,7	219	RS1300280-T46NA
30	40,7	4,2	30,7	30,5	30,4	0,7	220	RS1300300-T46NA
32	42,7	4,2	32,7	32,5	32,4	0,7	221	RS1300320-T46NA
35	45,7	4,2	35,7	35,5	35,4	0,7	222	RS1300350-T46NA
38	53,1	6,3	38,8	38,6	38,4	1,2	327	RS1300380-T46NA
40	55,1	6,3	40,8	40,6	40,4	1,2	328	RS1300400-T46NA
42	57,1	6,3	42,8	42,6	42,4	1,2	328	RS1300420-T46NA
45	60,1	6,3	45,8	45,6	45,4	1,2	329	RS1300450-T46NA
50	65,1	6,3	50,8	50,6	50,4	1,2	331	RS1300500-T46NA
55	70,1	6,3	55,8	55,6	55,4	1,2	332	RS1300550-T46NA

If engine coolant temperature becomes too low 60° (140°F) raw fuel will wash the lubrication of cyl. walls and dilute crank case oil so excessive wear will take place in engine moving parts.

Table VII Turcon® Stepseal® K-R Metric Ordering Information (Dimensions in mm)

Continued

Bore Dia.	Groove Dia.	Groove Width	Maximum Rod Bore Diameter B			Radius Max	O-Ring Nitrile	Turcon® Stepseal® K-R Turcon® T46
C f8	D H9	G+0,2	0-100 Bar	100-200 Bar	200-300 Bar	R	Dash No.	Part No.
60	75,1	6,3	60,8	60,6	60,4	1,2	334	RS1300600-T46NA
65	80,1	6,3	65,8	65,6	65,4	1,2	336	RS1300650-T46NA
70	85,1	6,3	70,8	70,6	70,4	1,2	337	RS1300700-T46NA
75	90,1	6,3	75,8	75,6	75,4	1,2	339	RS1300750-T46NA
80	95,1	6,3	80,8	80,6	80,4	1,2	340	RS1300800-T46NA
85	100,1	6,3	85,8	85,6	85,4	1,2	342	RS1300850-T46NA
90	105,1	6,3	90,8	90,6	90,4	1,2	344	RS1300900-T46NA
95	110,1	6,3	95,8	95,6	95,4	1,2	345	RS1300950-T46NA
100	115,1	6,3	100,8	100,6	100,4	1,2	347	RS1301000-T46NA
105	120,1	6,3	105,8	105,6	105,4	1,2	348	RS1301050-T46NA
110	125,1	6,3	110,8	110,6	110,4	1,2	350	RS1301100-T46NA
115	130,1	6,3	115,8	115,6	115,4	1,2	351	RS1301150-T46NA
120	135,1	6,3	120,8	120,6	120,4	1,2	353	RS1301200-T46NA
125	140,1	6,3	125,8	125,6	125,4	1,2	355	RS1301250-T46NA
130	145,1	6,3	130,8	130,6	130,4	1,2	356	RS1301300-T46NA
135	150,1	6,3	135,8	135,6	135,4	1,2	358	RS1301350-T46NA
140	155,1	6,3	140,8	140,6	140,4	1,2	359	RS1301400-T46NA
150	165,1	6,3	150,8	150,6	150,4	1,2	362	RS1301500-T46NA
160	175,1	6,3	160,8	160,6	160,4	1,2	363	RS1301600-T46NA
170	185,1	6,3	170,8	170,6	170,4	1,2	365	RS1301700-T46NA
180	195,1	6,3	180,8	180,6	180,4	1,2	366	RS1301800-T46NA
190	205,1	6,3	190,8	190,6	190,4	1,2	368	RS1301900-T46NA
200	220,5	8,1	201,1	200,8	200,5	1,5	445	RS1302000-T46NA
210	230,5	8,1	211,1	210,8	210,5	1,5	446	RS1302100-T46NA
220	240,5	8,1	221,1	220,8	220,5	1,5	447	RS1302200-T46NA
230	250,5	8,1	231,1	230,8	230,5	1,5	448	RS1302300-T46NA
240	260,5	8,1	241,1	240,8	240,5	1,5	449	RS1302400-T46NA
250	270,5	8,1	251,1	250,8	250,5	1,5	449	RS1302500-T46NA
260	284,0	8,1	261,1	260,8	260,5	1,5	450	RS1302600-T46NA
270	294,0	8,1	271,1	270,8	270,5	1,5	451	RS1302700-T46NA
280	304,0	8,1	281,1	280,8	280,5	1,5	452	RS1302800-T46NA
290	314,0	8,1	291,1	290,8	290,5	1,5	453	RS1302900-T46NA
300	324,0	8,1	301,1	300,8	300,5	1,5	454	RS1303000-T46NA
310	334,0	8,1	311,1	310,8	310,5	1,5	454	RS1303100-T46NA
320	344,0	8,1	321,1	320,8	320,5	1,5	455	RS1303200-T46NA
330	354,0	8,1	331,1	330,8	330,5	1,5	456	RS1303300-T46NA
340	364,0	8,1	341,1	340,8	340,5	1,5	457	RS1303400-T46NA
350	374,0	8,1	351,1	350,8	350,5	1,5	458	RS1303500-T46NA
360	384,0	8,1	361,1	360,8	360,5	1,5	458	RS1303600-T46NA
370	394,0	8,1	371,1	370,8	370,5	1,5	459	RS1303700-T46NA
380	404,0	8,1	381,1	380,8	380,5	1,5	460	RS1303800-T46NA
390	414,0	8,1	391,1	390,8	390,5	1,5	461	RS1303900-T46NA
400	424,0	8,1	401,1	400,8	400,5	1,5	461	RS1304000-T46NA

Continuous operation of engine below 60° and above 100°C can damage the engine.

Wear Ring Dimensional Data Piston

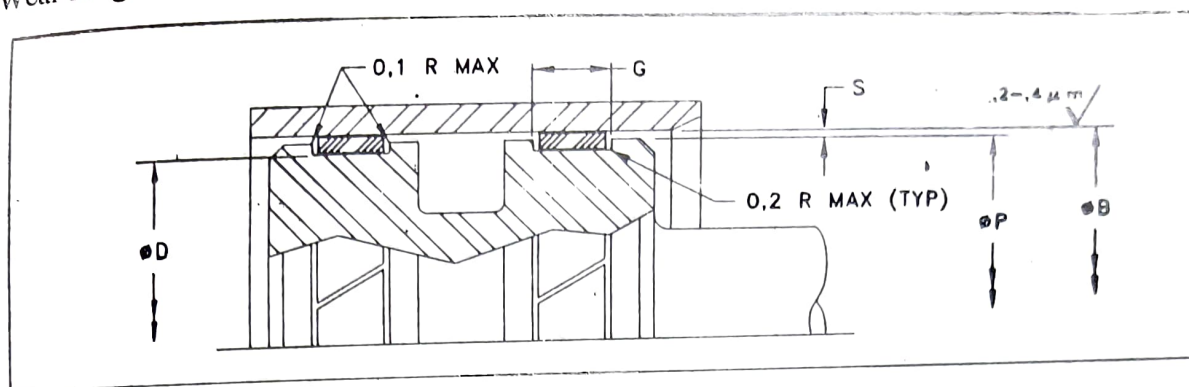


Table XIV Wear Ring Ordering Information Piston (Dimensions in mm)

Series No.	Bore Diameter B H9	Groove Dia. D h9	Groove Width G + 0,2	Radial Clearance S
GP65	16-140,0	B - 5,00	5,60	0,25-0,50
GP69	60-220,0	B - 5,00	9,70	0,25-0,70
GP73	130-400,0	B - 5,00	15,00	0,25-0,90

Series No.	Bore Diameter B H9	Groove Dia. D h9	Groove Width G + 0,2	Radial Clearance S
GP75	320-999,9	B - 5,00	25,00	0,25-1,10
GP99	100-999,9	B - 8,00	9,70	0,25-1,50

Wear Ring Dimensional Data Rod

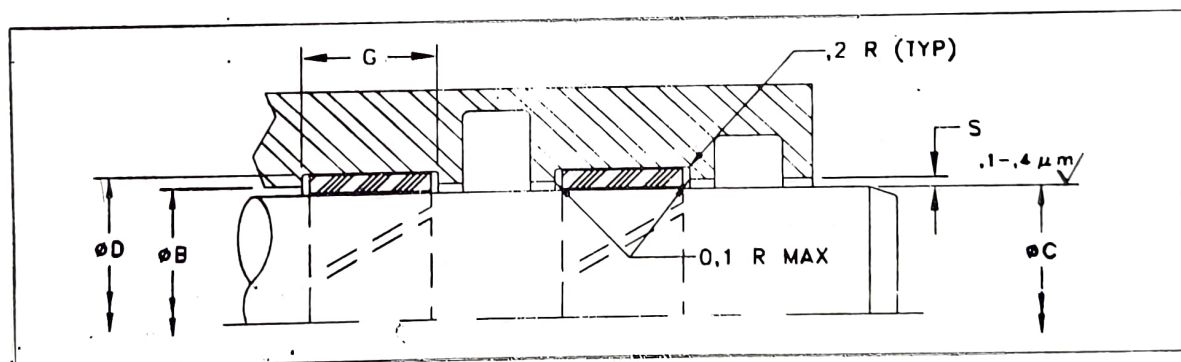


Table XV Wear Ring Ordering Information Rod (Dimensions in mm)

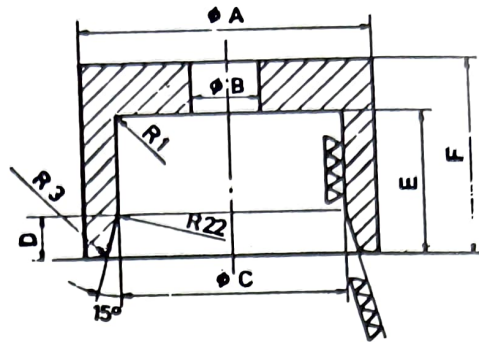
Series No.	Rod Dimensions B H9	Groove Dia. D h9	Groove Width G + 0,2	Radial Clearance S
GR65	15-140,0	C + 5,00	5,60	0,25-0,50
GR69	32-220,0	C + 5,00	9,70	0,25-0,70

Series No.	Bore Dimensions C F8	Groove Dia. D h9	Groove Width G + 0,2	Radial Clearance S
GR73	80-400,0	C + 5,00	15,00	0,25-0,90
GR75	200-999,9	C + 5,00	25,00	0,25-1,10

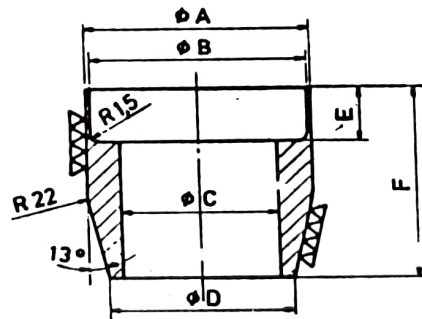
Engine misfire

- Vibration
- Sudden change in engine operating temperature or oil pressure

- Excessive smoke
- Loss of Power.
- An increase in fuel consumption

CALIBRATING SLEEVE

PISTON ϕ	A	B	CH7	D	E	F	PLASSER PART NO.
40	55	15	40	10	35	50	VB 1386-02
50	65	15	50	10	35	50	VB 1387-02
63	80	15	63	15	60	80	VB 1388-02
80	100	15	80	15	60	80	VB 1391-02
100	120	60	100	15	50	70	VB 1391-02
125	150	80	125	15	65	85	VB 1392-02

TOOL FOR FITTING THE RINGS:

PISTON ϕ	A	B	C	D	E	F	PLASSER PART NO.
40	40,5	39,5	24	31	12	40	VB 1386-01
50	50,5	49,5	35	41	12	45	VB 1387-01
63	63,5	62,5	45	52	12	50	VB 1388-01
80	80,5	79,5	60	70	15	50	VB1390-01
100	100,5	99,5	75	88	15	50	VB 1391-01
125	125,5	124,5	100	114	15	50	VB 1392-01

Mechanical over tightening can distort the threads or damage the filter element seals.

PROPORTIONAL VALVES AND SERVO VALVES

M.M. MUKHERJEE
SR. INSTRUCTOR
IRTMTC - ALD

GENERAL :

With the advancement of Science and Technology, there has been a dramatic and revolutionary change that has taken place in the field of hydraulics by the latest introduction of proportional valves and Servo valves.

Normally before the use of these valves, we have been utilising Conventional Valves which are 'Yes' or 'No' type valves i.e. to say either these valves will be completely 'Off' or 'No', that means either the ports will be completely closed or open and these types of valves are known as finite-positioning valves. Under the system of operation, here the movement of actuator is not controllable.

But in order to have a controlled and measured amount of actuation, another type of valves known as proportional valves and servo valves has been introduced and such types of valves are known as infinite positioning valves. These types of valves are preferably known as direction-cum-flow control valves. Here we mean to say that we would like to have a measured amount of correction or actuation and accordingly the movement of spool of the valves is also proportional to the current. This means whatever amount of correction we need, that much only would be done. Neither this will be less nor will be more. Normally these valves are not used when the use is not meant for precise-operation or it is a conventional use.

The introduction of these unless are meant for precise, sophisticated, fine and delicate application and these are very much sensitive to the controlling signal.

PROPORTIONAL - VALVES :

As the name implies, its operation is proportional to signal it receives i.e., its movement will be such that it corresponds to the controlling signal. Higher the amount of signal, higher will be actuation, Lower the amount of signal, lower will be actuation. In modern technology, we need a proportional movement and proportional actuation.

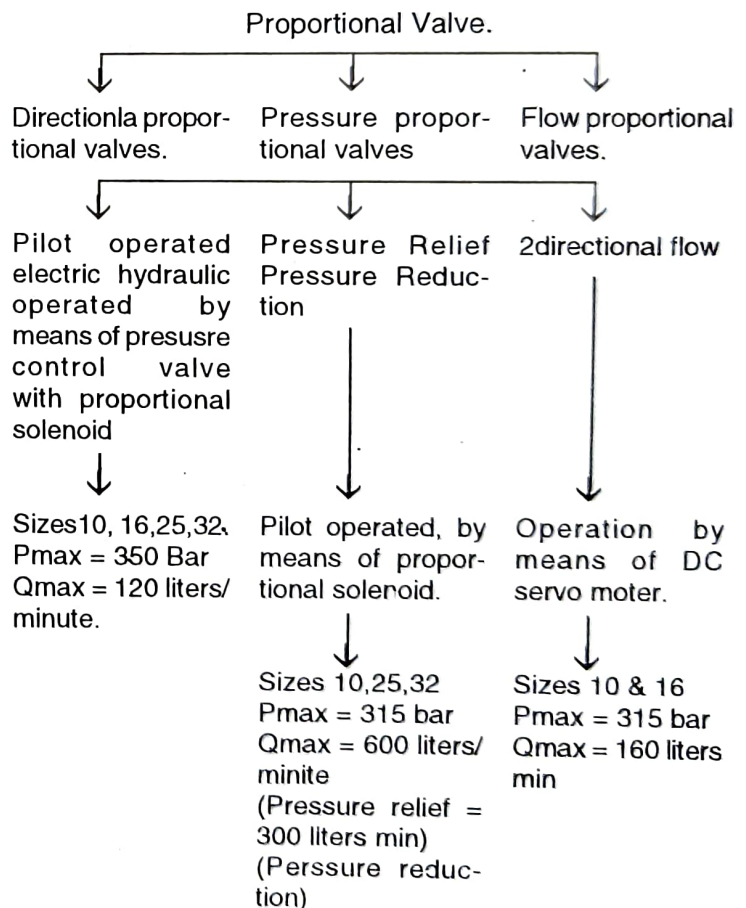
As we know, there has been a further modification over a normal conventional D.C. valve in which we have added another portion in it, known as pilot of valve. Normally when the actuator is not so much heavy and it does not require so much amount of oil, we do work with the help of a normal conventional DC valve. But at the time when load is heavier and spool, of the valve is bigger in diam-

eter and we require larger amount of oil supply, because in this case 24VDC is not sufficient to move the spool of the valve we need a pilot - operation and in this way, the pilot spool is operated first and after with the combination of hydraulic force and electric voltage, the main of the working spool is actuated (bigger dia) and ports being bigger, higher amount of oil supply is achieved which is responsible for the movement of the actuator.

Based upon the same principle, the proportional valve does function in similar manner and it invariably has a pilot operation, the top portion of the valve which is required to be operated first and this energisation is further transmitted to the main or working spool of the valve.

CLASSIFICATION OF PROPORTIONAL VALVE :

The classification of proportional valve is done in the following way.



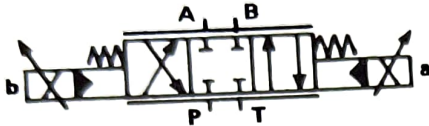
During bleeding fuel system avoid spilling of fuel on heated exhaust it may create a fire

DIRECTIONAL - PROPORTIONAL VALVES :

Complex control produces the Programmed sequences of user, such as acceleration, movement deceleration, can be controlled using a direction proportional valve. One unit determines the direction of movement and the speed.

The out put flow is proportional to the electrical input signal servo units behave the same and as with servo valves, proportional valves not only control the operation, but also the regulation, of a hydraulic circuit.

The 4-way directional proportional valves consists of a pilot valve and the main valve.



The pilot valve is a pressure regulating valve with proportional solenoid i.e. an adjustable oil immersed DC solenoid. It changes an electrical input signal into a proportional force. An increase of current causes a corresponding increase in solenoid force.

In order to achieve smooth power delivery, only a part of solenoid stroke available is used.

The pilot valve comprises to housing 3 two pilot spools 3 and 5 and two proportional solenoids 6 and 7.

The main valve is a directional control valve and comprises the housing 8, main spool 2 and centering springs 10 and 11.

At input signal 0 both spring chambers of the main valve 12 and 13 are unloaded to the 'Y' port via bores in the pilot spool.

The main spool 9 is held in centre position by the centering springs 10 and 11.

At input signal 0, both spring chambers of the main valve 12 and 13 are unloaded to the 'Y' port via bores in the pilot spool.

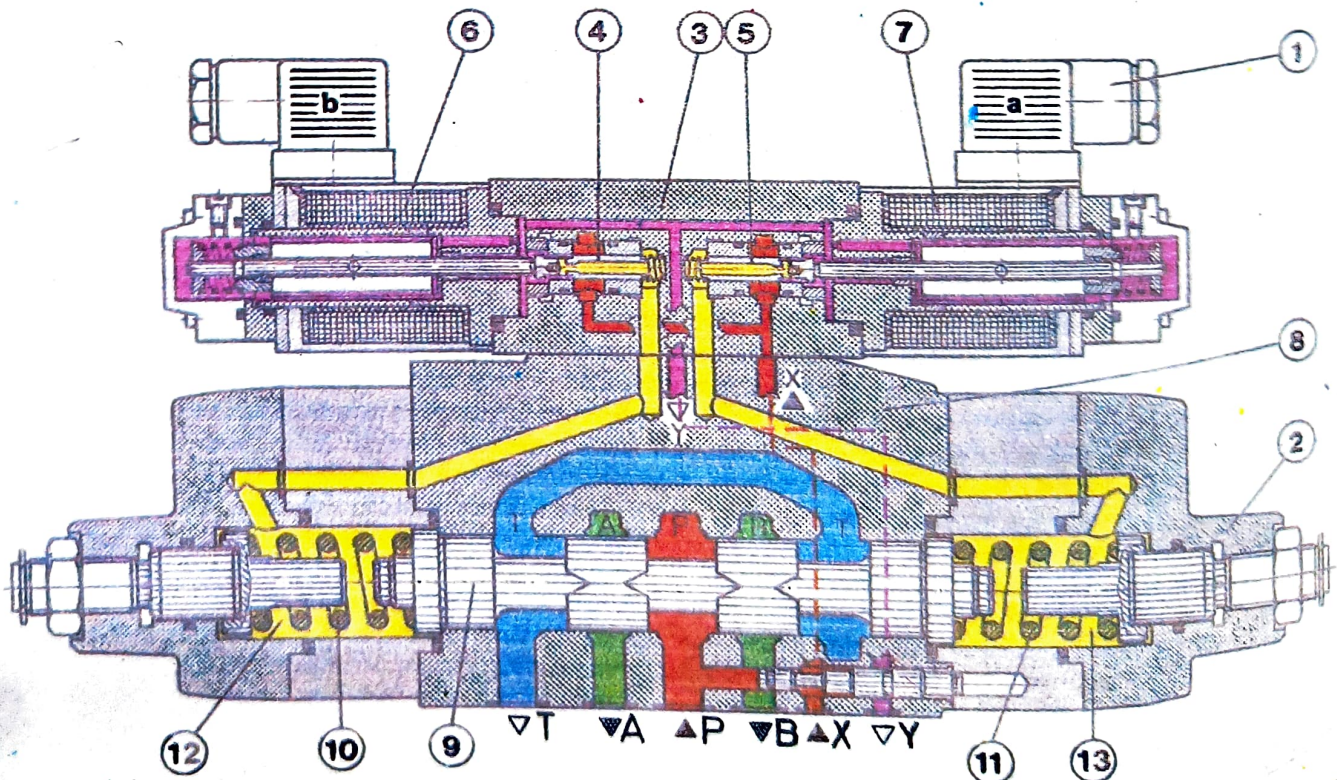
The main spool 9 is held in centre position by the centering springs 10 and 11.

If, for example solenoid 6 is energised, the pilot spool 3 is pushed to the right. Pilot oil (Internal from 'P' or external by means of port X) now reaches the spring chamber 4 by means of the cross and horizontal bore in the pilot spool closes the oil path from the main spring chamber to position 'Y'.

Pressure build up in the spring chamber according to the solenoid force (Pressure regulating valve), only that here the spring forces replaced by solenoid force.

The pilot pressure proportional to the input Current, pushes the main spool against the spring 11, until the pressure and spring force are equal.

Higher solenoid force & higher control pressure & longer spool stroke.



A certain flow therefore results, related to the input current, orifice type throttle sections with non-linear flow characteristics results form the spool type.

Special mention must be made of the switching and transition behaviour. The change-over from the closed to the open position is always controlled. There are no step type transitions during the opening phases as with standard directional control valves.

The metering notches and spool control are arranged such a way that controlled opening and closing of the flow position occur in a progressiv manner.

The return of pilot spool 4 to neutral position at signal 0 and thus also the return of the main spool to its natural position are not related to the control pressure.

The directional proportional valves can also be fitted with a pressure compensator. It is arranged in a sandwich plate under the proportional valve. In this way a flow characteristic corresponding to that of a flow control valve is achieved which is not related to the pressure drop at the throttle-portion.

The pressure compensator can be used in the supply line as a 2 or 3 directional flow regulator.

A pressure compensator can also be used for several proportional valves built on a sandwich plate.

Important technical data.

Size 10 - 32

Operating Pressure upto 350 bar.

Flow Upto 1200L/minute.

Directional Proportional valves are generally controlled by means of the electrical amplifier type VI-3000.

Proportional valve as given in the figure compreses of.

1. Supply voltage, voltage controller.
2. Call-up-Relay d_1 - d_4 to switch-over the nominal valves.
3. Internal nominal valve trimmer(nominal valve adjustment).
4. External nominal valve adjustment.
5. Ramp connector (0.1.....5 Sec.)

The rate of change of the input signal can be adjusted by the ramp connector.

6. Function connector.

The overlap at the main spool of the prooportional valve is jumped over during switching process in order to avoid idle time.

7. Diodes for directional control.

Upper diode allows through (H voltage.)

(Lower diode allows through(-) voltage)

8. Invertor stage for equalisation of the signal.

(+ voltage is changed to - voltage)

9. Voltage constant for solenoid --- "a".

(Fixed current generator)

10. Voltage constant for - solenoid --- "b"

(Fixed current generator)

The voltage constant operates with impressed current, so that the current remains fixed when resistance changes (temperatures) change). P8 and P9 dead current solenoid is pre-energised to obtain switching times.

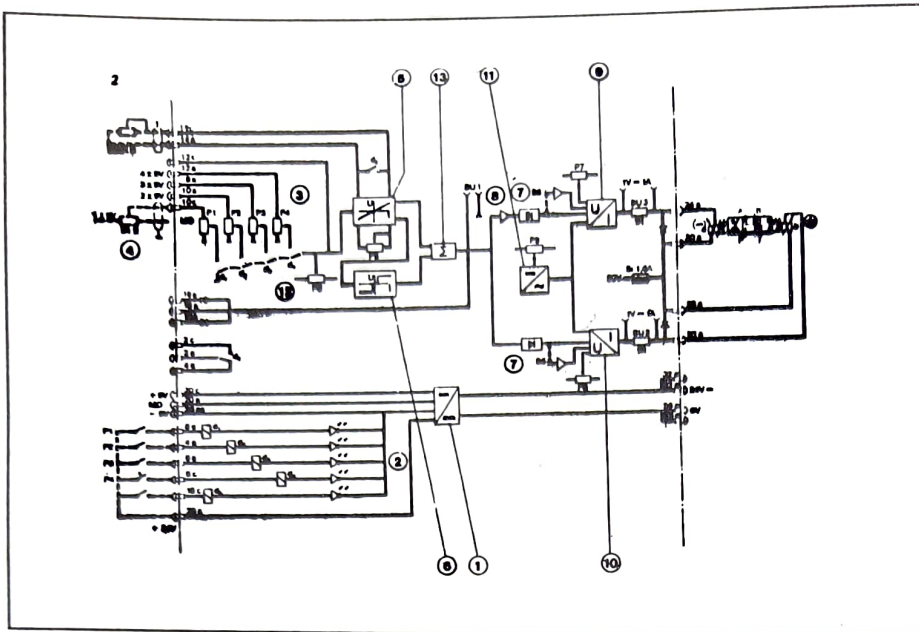
11. Dither generator, to improve the hysteresis P7 dither current.

12. P5 off set trimmer setting of zero-point, irregulanties of the part; are balanced out the setting is carried out at the factory.

13. Summator, for the addition of ramp and function generator.

Acceleration and decelration processes can be carried out very simple using these control electronics.

The velves required are put in via the electronics and are not dependent on hydraulics (oil-viscosity)



PRESSURE RELIEF VALVE WITH PROPORTIONAL SOLENOID :

As shown in the figure this valve comprises a pilot valve with proportional solenoid 2, optionally with integral maximum pressure protection 3 and the main-valve 4.

The basic function corresponds to that of the pilot operated relief valve type DB. The difference is in the pilot valve. A proportional valve is used here in place of the

spring and the pilot valve adapted accordingly.

The system pressure setting is related to the proportional solenoid current. Higher input current means greater solenoid force and thus a higher pressure setting.

As shown in the figure, the maximum pressure. Protective valve, which prevents pressure exceeding the maximum. Permissible system pressure, if, for example, there is damage to the electronics and maximum electrical control currents is developed.

As shown in the figure an electrical amplifier (Type VT 200) is used to control solenoids. Two trimmers to set the zero current and the maximum pilot current are in the amplifier.

The system pressure can be remote controlled by means of the potentiometer connected to the amplifier.

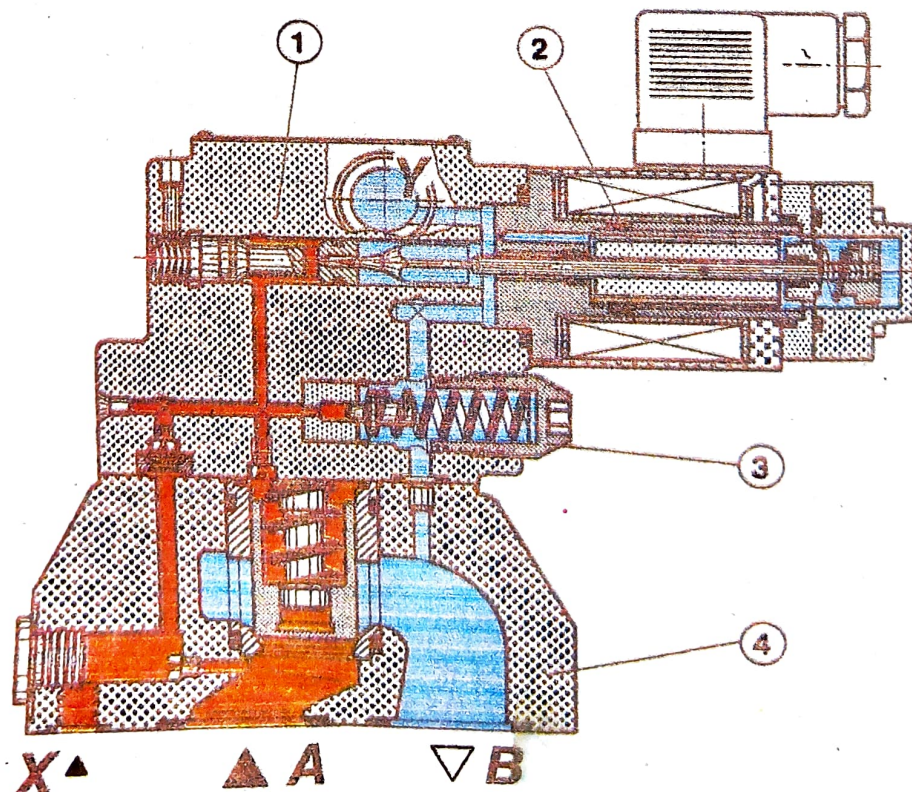
Important Technical data :

Sizes. 10, 25, 32

Operating pressure upto 315 bar.

Flow. upto 600L/minute.

Along with the pressure relief valve, the pressure reducing valve (Sizes 10, 25 and 32) is also available with proportional solenoid control.



SERVO - VALVES

The term "Servo" is used a great deal. In general, it is used to describe the function where a small input (Input signal) causes a large output (Output signal).

The servo steering in a car must be known to all of us whereby the steering wheel is moved with only little force, but transmits great force to the wheels.

In servo hydraulics, the function is similar. a low power control signal, e.g 0.08 watt, can give analogous control of several 100KW. However, the servo valve does not only ful-fil the requirements of analogous control. As opposed to proportional valves, it is generally used in electro-hydraulic regulating circuits, e.g. position regulating circuit (holding a position under load or given speed).

In hydraulics, terms control and regulate are used in general way. Control means in regulating technology that a nominal valve is given and the actual - valve results from a fixed setting at the unit. The actual valve is not monitored and therefore not corrected.

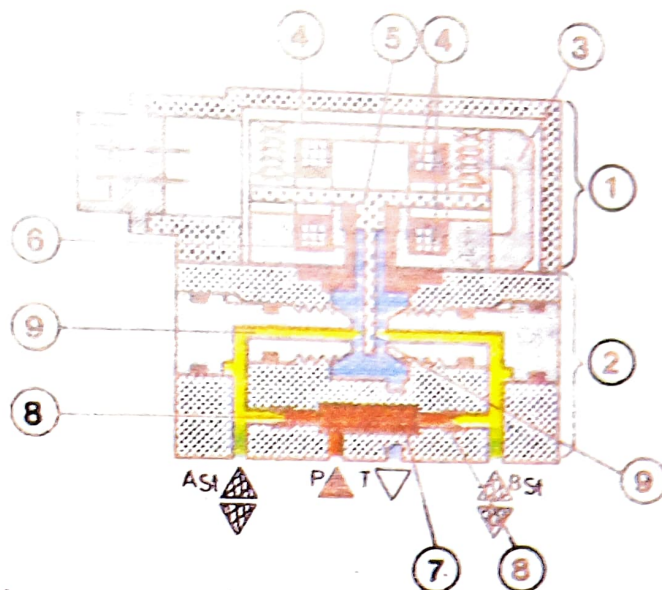
As example from hydraulic applications; the required control speed would result from a given flow through a flow control valve at a certain setting.

With "regulation" a nominal valve (Command variable) is given. The actual valve resulting from this is measured.

Continuously - It is the actual valve differs from the nominal valve, a signal is formed from the difference, which influences the system so that the actual valve is equated to the nominal value. The purpose of the regulation is therefore to equate the actual value to the command variable in spite of unfavorable influences.

In the servo valve, a small electrical input signal undergoes an analogues change into a hydraulic out put signal. (Pressure flow).

The two stage directional servo valve compresses mainly the first stage (el. control motor 1 and hydr. amplifier 2) and the second stage as given in figure below.



The control motor 1. (with permanent solenoid 3 control coils 4 and armature with flapper plate 5) changes a small Current signal into a proportional flapper plate movement.

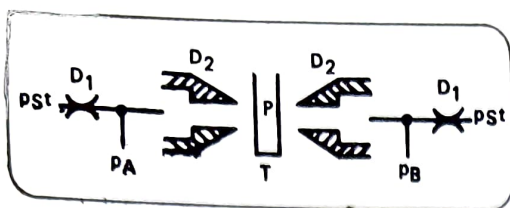
the armature and the Fapper plate are one part, which is shock mounted to a thin-walled flexible pipe. At the same time, the pipe seals control motor to keep it dry from Hyd. fluid, the control coils are energised by means of a current signal and the armature deflected against the spring force of the pipe. the direction of flecion is determined by the polarity of the input current.

The torque on the pipe and thus the defection of the flapper plate is proportional to the control current. When the control current is shut off the pipe (return spring) brings the armature and thus also the flapper plate back in to centre-position. The torque transmission of this type of control motor has the following advantages.

No friction, low hysteresis, and a sealing hydraulic medium / control motor (no magnetic field in the pressure medium)

The deflection of the flapper plate is transformed into a hydraulic valve in the hydraulic amplifier the jet flapper plate system is used as hydraulic amplifier.

Avoid prolonged and repeated skin contact with used antifreeze, such contacts can cause skin disorder or other bodily injury and thoroughly wash after contact. The radiator should be slowly filled to prevent air locks.

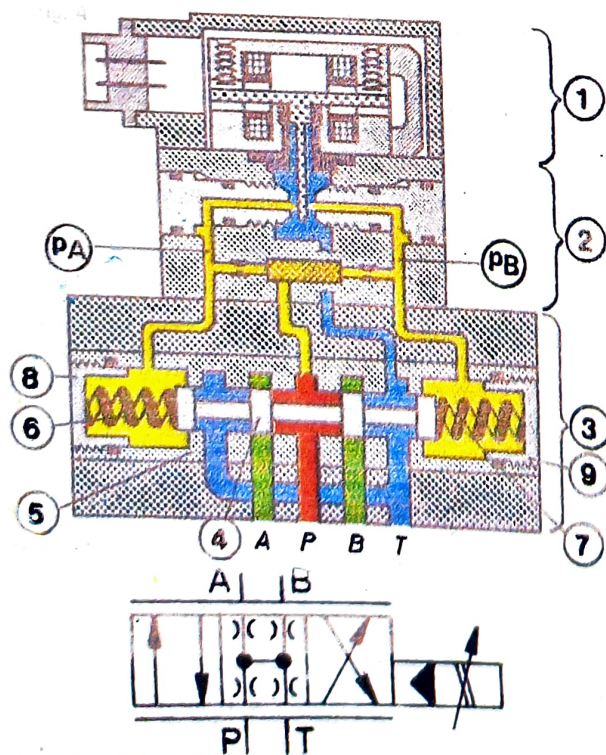


The system comprises 2 fixed jets D_1 and 2 control jets D_2 . The control pressure P_{st} on both sides is reduced by means of jets D_1 and D_2 (=voltage decrease via ele. resistance). If the jet sections are of equal size, and equal reduction in pressure via the jets occurs (e.g. $P_{st} = 100$ bar, $P_A = 50$ bar, $T = 0$).

When the flapper plate 'P' is deflected, the distances between the regulating jets change, for example deflected, the distances between the regulating jets change, for example defalcation to the left:

The distance of the plate to D_2 on the left decreases to D_2 on the right increases Pressure at P_A and P_B change in. reverse accordingly. Pressure P_A increases. Pressure P_B decreases. The pressure drop $P_A - P_B$ is taken as usable signal.

The following diagram shows the change in pressure related to the inlet current.



Do not add cold coolant in radiator when the engine is running it may cause cracks in head due to sudden cooling.

The jets are synchronised and adjusted to one another in such a way that the pressure difference shown results from a linear change in current.

The complete system is shown under Item 2 in the sectional diagram.

Pilot oil is supplied from port 'P' by means of a small pressure line filter '7' to the fixed jets 8 and further to the control jets 9.

Pressure P_A and P_B is measured at ports A_{ST} and B_{ST} between the fixed and control jets.

Control motor - 1: Change current i into distance S .

HYDR. Amplifier - 2: Changes distance S into pressure drop ΔP .

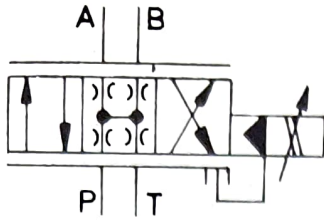
Second Stage - 3: Changes pressure drop ΔP to flow Q .

The second is a control valve, whose control spool is in a wear resistant bush 5 or directly in the housing if it is a simple - model. The spool is centered between 2 pressure springs 6 and 7. The control and control bush machined to suit one another in such a way, that almost zero overlap is achieved. Depending on the system, either a slight positive or a slight negative overlap is required in practice.

As inlet signal zero ($i = 0$) at the first stage the flapper plate is in the centre - the pressure between the fixed and control jets is equal ($P_A = P_B$). the same pressure affects both sides of the control spool. The spool is in neutral position with the overlap shown, ports P, A, B, and T are blocked. If the flapper plate is now deflected to the left by means of a control signal, pressure rises in spring chamber 6 and pressure in spring chamber 7 decreases, at the same time. The pressure drop pushes the control spool 4 to the right against spring 7, until the forces on both sides of the spool are in balance again.

The spool has reached its position. As pressure drop increases, i.e. greater input signal, the control spool moves further in one or other direction. The greater the spool stroke, the greater the opening section from P to A or B the greater the flow - the greater the actuator speed.

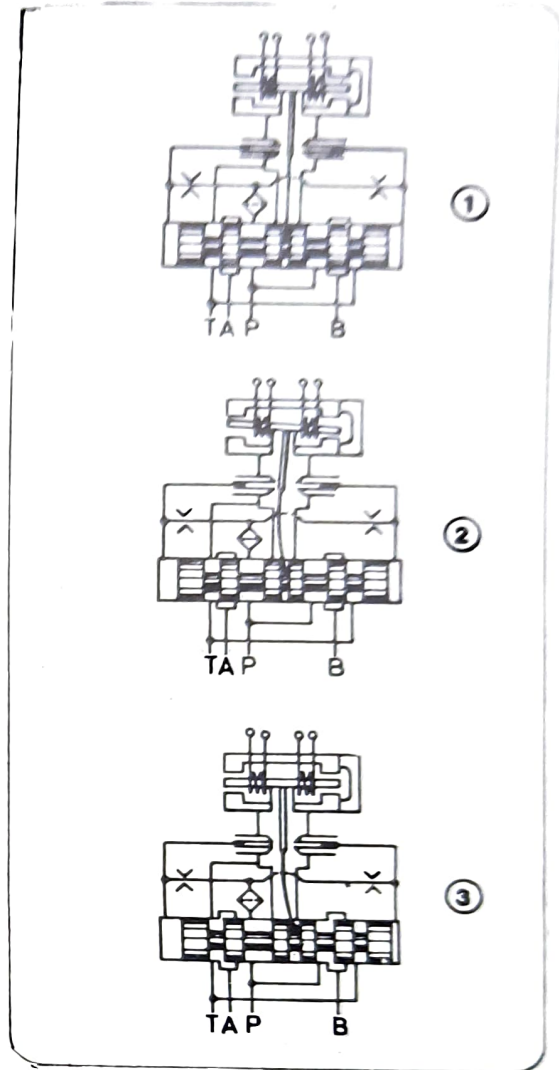
The springs and thus the spool position related to the control lands can be adjusted externally by means of adjustment screws 8 and 9.



1. Valve in neutral position.
2. Flapper plate is deflected.
3. Spool has reached its position.

MECHANICAL FEED BACK :

With mechanical feed back, the control spool is connected to the control motor of the first stage by means of a feed back spring. The spring exerts a torque against the control motor torque. When the required spool position is reached, the torque of the control motor is equal to the vouching torque of the feed back spring. The flapper plate is returned to the centre-position. The torque equality leads to a pilot pressure balance and maintenance of the spool position. Spool stroke and flow are therefore proportional to the input current



Before removing coolant system pressure cap let the temprature drop below 50°C. If ignored (one can cause) personnel injury from heated coolant spray.

EDITORIAL

Dear Reader 12th issue of IRTM digest is now with you to provide theoretical and practical knowledge related to track machines. No issue has been brought out during July 96 & oct 96 as no article is coming up from field units of Track Machine organisation of Indian Railways. This is your Digest please contribute your ideas to improve its quality. Please send your articles, experiences, notes and suggestions which you think would make interesting and informative reading to other readers of the Digest.

You are welcome to give ideas, how to improve this Digest, its contents and its presentation. Any reader can contribute articles related to track machine for improvement in operation, maintenance, overhauling, and quality control.

Thanks.

SURYA PRAKASH

Principal

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