MODEL 5381
PRESSURE REDUCING SANITARY REGULATOR

SECTION I

I. DESCRIPTION AND SCOPE

Model 5381 is a pressure reducing regulator used to control downstream (outlet or P_2) pressure. Inlet and outlet size is 1/2" (DN15) with Tri-Clamp® connections. The 5381 incorporates a stainless steel body. Refer to Technical Bulletin 5381-TB for specific design conditions and selection recommendations.

SECTION II

II. INSTALLATION

⚠ CAUTION

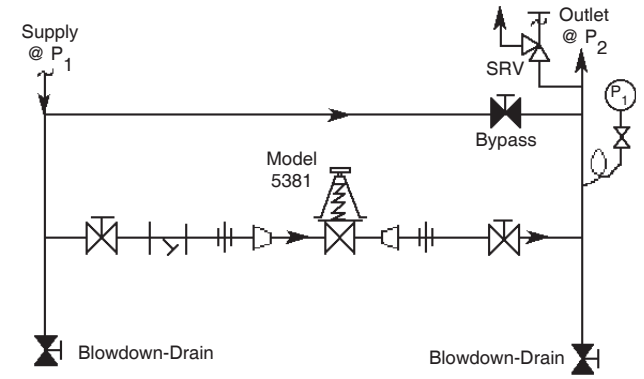
Installation of adequate overpressure protection is recommended to protect the regulator and all downstream equipment from damage in the event of regulator failure.

1. An inlet block valve should always be installed upstream of the regulator.

2. If service application is continuous such that shutdown is not readily accomplished, it is recommended that an inlet block valve, outlet block valve, and a manual bypass valve be installed.

⚠ CAUTION

The maximum outlet pressure is listed on the nameplate as the upper range spring pressure level, and is the recommended "upper operative limit" for the sensing diaphragm (see Section IV. Startup, Step 7). Higher pressures could damage the diaphragm. (Field hydrostatic tests frequently destroy diaphragms. DO NOT HYDROSTATIC TEST THROUGH AN INSTALLED UNIT; ISOLATE FROM TEST.)



Recommended Piping Schematic
For Pressure Reducing Station

3. An outlet pressure gauge should be located approximately ten pipe diameters downstream, and within sight.

4. All installations should include a downstream relief device if the inlet pressure could exceed the pressure rating of any downstream equipment or the maximum outlet pressure rating of the unit.

5. Flow Direction: Install so the flow direction matches the arrow stamped on the regulator body.

6. Install in well drained horizontal pipe, properly trapped with spring chamber (2) in the vertical position to allow for proper draining.

SECTION III

III. PRINCIPLE OF OPERATION

1. Movement occurs as pressure variations register on the diaphragm. The registering pressure is the outlet, P_2, or downstream pressure. The range spring opposes diaphragm movement. As outlet pressure drops, the range spring pushes the diaphragm down, opening the port; as outlet pressure increases, the diaphragm pushes up and the port opening closes.
2. A complete diaphragm failure will cause the regulator to fail open.

SECTION IV

IV. STARTUP

1. Start with the block valves closed. A bypass valve may be used to maintain outlet pressure in the downstream system without changing the following steps.
2. Relax the range spring by turning the adjusting knob (30) counter clockwise (CCW) a minimum of three (3) full revolutions. This reduces the outlet (downstream) pressure set point.
3. If it is a "hot" piping system and equipped with a bypass valve, slowly open the bypass valve to pre-heat the system piping and to allow slow expansion of the piping. Assure proper steam trap operation if installed. Closely monitor outlet (downstream) pressure via gauge to assure not over-pressurizing. ***NOTE:*** *If no bypass valve is installed, extra caution should be used in starting up a cold system; i.e. do everything slowly.*
4. Crack open the outlet (downstream) block valve.
5. Slowly open the inlet (upstream) block valve observing the outlet (downstream) pressure gauge. Determine if the regulator is flowing. If not, slowly rotate the regulator's adjusting knob clockwise (CW) until flow begins.
6. Continue to slowly open the inlet (upstream) block valve until fully open.
7. Continue to slowly open the outlet (downstream) block valve, especially when the downstream piping system isn't pressurized. If the outlet (downstream) pressure exceeds the desired pressure, close the block valve and go to Step 2, then return to Step 4.
8. When flow is established steady enough that the outlet (downstream) block valve is fully open, begin to slowly close the bypass valve if installed.
9. Develop system flow to a level near its expected normal rate, and reset the regulator set point by turning the adjusting knob CW to increase outlet pressure, or CCW to reduce outlet pressure.
10. Reduce system flow to a minimum level and observe set point. Outlet pressure will rise from the set point of Step 9. The maximum rise in outlet pressure on decreasing flow should not exceed the stated upper limit of the range spring by greater than 10%; i.e. 20-80 psig (1.38-5.52 Barg) range spring, at low flow the outlet pressure should not exceed 88 psig (6.07 Barg), if it does, consult factory.

SECTION V

V. SHUTDOWN

1. On systems with a bypass valve, and where system pressure is to be maintained as the regulator is shut down, slowly open the bypass valve while closing the inlet (upstream) block valve. Fully close the inlet (upstream) block valve. (When on bypass, the system pressure must be constantly observed and manually regulated. Close the outlet (downstream) block valve.

⚠ CAUTION

Do not walk away and leave a bypassed regulator unattended.

2. If the regulator and system are to both be shut down, slowly close the inlet (upstream) block valve. Close the outlet (downstream) valve only if regulator removal is required.

SECTION VI

VI. MAINTENANCE

⚠ WARNING

SYSTEM UNDER PRESSURE. Prior to performing any maintenance, isolate the regulator from the system and relieve all pressure. Failure to do so could result in personal injury.

A. General:

1. Maintenance procedures hereinafter are based upon removal of the regulator unit from the pipeline where installed.
2. Owner should refer to owner's procedures for removal, handling, cleaning and disposal of nonreusable parts, i.e. gaskets, etc.
3. Refer to Figure 2 for basic regulator, item number reference ( ).

B. Diaphragm Replacement:

⚠ CAUTION

To prevent damage to body, use lead jaws when clamping body in a vise. Position body so that vise does not close over inlet and outlet connections.

1. Securely install the body (1) in a vise with the spring chamber (2) oriented upwards.

⚠ WARNING

SPRING UNDER COMPRESSION. Prior to removing spring chamber, relieve spring compression by backing out the adjusting knob. Failure to do so may result in flying parts that could cause personal injury.

2. Relax range spring (17) by turning adjusting knob (30) CCW until removed from spring chamber (2).
3. Loosen spring chamber (2) by placing wrench on "flats" and rotating CCW making sure **not** to use the flat where the vent hole is located.
4. Remove spring chamber (2), range spring (17) and spring button (5).
5. Remove the diaphragm subassembly consisting of the pressure plate nut (10), lock washer (9), pressure plate (3), diaphragm (13), pusher plate O-ring (15) and pusher plate (4). ***NOTE:*** *Refer to the quantity of diaphragms (13) incorporated per the bill of materials listing. Depending on outlet pressure level, multiple metal diaphragms may be "stacked".*

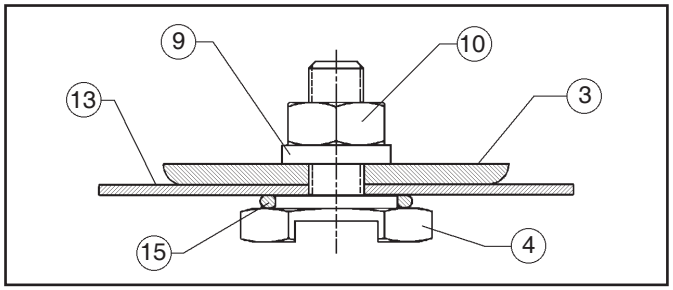


Figure 1: Diaphragm Subassembly

6. Loosen pressure plate nut (10) and separate all parts (3, 4, 9, 13 & 15) of the diaphragm subassembly.
7. Inspect pressure plate (3) to assure no deformation due to over-pressurization. If deformed, replace.
8. Remove diaphragm gasket (14). (If a composition diaphragm is used there is no diaphragm gasket (14).
9. Clean inside body surfaces in accordance with Owner's cleaning procedures. Do not scratch diaphragm O-ring seating surface ***NOTE:*** *Maintenance must include a level of cleanliness equal to Cashco cleaning standard #S-1576. Contact factory for details.*
10. Reassemble diaphragm subassembly by placing pusher plate O-ring (15), diaphragm(s) (13), pressure plate (3) and lock washer (9) over the threaded post of pusher plate (4). Assure the pressure plate (3) is placed with curved outer rim down next to the diaphragm (13) surface. Tighten pusher plate nut (4) to the following torque values:

Sizes	Diaphragm	Torque Value	
ALL	Metal	60 in/lbs.	(6.8 Nm)
	Composition	15 in/lbs.	(1.7 Nm)

11. For metal diaphragm(s) (13), place diaphragm gasket (14) into body recess (none required for composition diaphragm). Set diaphragm subassembly into the body.

12. Place the range spring (17) over the pressure plate nut (10) of the diaphragm subassembly.

13. Apply a small amount of process compatible anti-seeze into depression of spring button (5) where adjusting screw (8) bears. Set spring button (5) onto range spring (17); ensure spring button (5) is laying flat on top of the spring.

14. Inspect body (1) and spring chamber (2) threads for debris. ***NOTE:*** *Apply a small amount of process compatible anti-seeze to spring chamber (2) threads to prevent galling.* Rotate the spring chamber (2) CW by hand into the threaded portion of the body (1) ensuring to not cross thread. Tighten spring chamber (2) to body (1) connection to a **30–35 Ft-lbs (41–47 Nm) torque value**.

15. Reinstall adjusting knob (30) with locknut (11) into the spring chamber (2).

16. Pressurize with air and spray liquid leak detector to test around body (1) and spring chamber (2) for leakage. Ensure that an outlet pressure is maintained during this leak test of at least mid-range spring level; i.e. 20-80 psig (1.4–5.5 Barg) range spring, 50 psig (3.4 Barg) test pressure minimum.

C. Trim Replacement

⚠ CAUTION

To prevent damage to body, use soft jaws when clamping body in a vise. Position body so that vise does not close over inlet and outlet connections.

1. Secure body (1) in a vise with the body cap (6) oriented up and the spring chamber (2) directed downwards.

2. Remove body cap (6) by rotating CCW. Remove o-ring (29).

3. Remove piston spring (7) and piston (16). ***Note:*** *The seat and piston (16) guide are integral parts of the body (1) casting. Inspect integral seat and parts for excessive wear, especially at seating surfaces. Replace if worn, nicked or depressed. If integral seat is nicked, use seat lapping compound to remove.*

NOTE: *When piston (15) assemblies are used with comp seats, Cashco, Inc. does not recommend attempting to remove the comp seat. If composition seat is damaged, replace entire piston assembly.*

4. Clean flat mating surfaces of body (1) to body cap (6) shoulder. Be careful not to scratch either surface.

5. Clean debris from within the body (1) cavity. Clean all parts to be reused according to owner's procedures. ***NOTE:*** *Maintenance must include a level of cleanliness equal to Cashco cleaning standard #S-1576. Contact factory for details.*

6. Place the piston (16), stem first, into the body cap (6) cavity.

7. Place piston spring (7) over spring hub of the piston (16).

8. Place o-ring (29) in body cap (6).

9. Apply a small amount of process compatible anti-seeze to the body cap (6) threads. Thread body cap (6) into body (1). Impact until body cap is metal to metal against body.

10. Bench test unit for suitable operation. ***NOTE:*** *Regulators are not tight shutoff devices. Even if pressure builds up beyond set point, a regulator may or may not develop bubble tight shutoff.* In general, tighter shutoff can be expected with composition seat.

11. Pressurize with air and spray liquid leak detector to test around body cap (6) and body (1) for leakage. Test pressure should be a minimum of 100 psig (6.9 Barg) at the inlet.

SECTION VII

VII. TROUBLE SHOOTING GUIDE

1. Erratic operation; chattering.

Possible Causes	Remedies
A. Oversized regulator; inadequate rangeability.	A1. Check actual flow conditions, re-size regulator for minimum and maximum flow. A2. Increase flow rate. A3. Decrease regulator pressure drop; decrease inlet pressure by placing a throttling orifice in inlet piping union. A4. Install next step higher range spring. Contact factory. A5. Before replacing regulator, contact factory.
B. Worn piston; inadequate guiding.	B. Replace trim (possible body replacement).
C. Weakened/broken piston spring.	C. Replace piston spring. Determine if corrosion is causing the failure.

2. Regulator can't pass sufficient flow.

Possible Causes	Remedies
A. Regulator undersized.	A1. Confirm by opening bypass valve together with regulator. A2. Check actual flow conditions, re-size regulator; if regulator has inadequate capacity, consult factory.
B. Incorrect range spring (screwing in CW of adjusting screw does not allow bringing pressure level up to proper level).	B. Replace range spring with proper higher range. Contact factory.
C. Too much droop.	C1. Review droop expected. C2. Contact factory.

3. Leakage through the spring chamber vent hole.

Possible Causes	Remedies
A. Normal-life diaphragm failure.	A. Replace diaphragm.
B. Abnormal short-life diaphragm failure.	B1. Can be caused by excessive chattering. See No. 1. to remedy chatter. B2. Can be caused by corrosive action. Consider alternate diaphragm material. B3. For composition diaphragms, assure not subjecting to over-temperature conditions. B4. Downstream (outlet) pressure buildup occurring that overstresses diaphragms. Relocate regulator or protect with safety relief valve.
C. O-ring failure.	C. Replace O-ring (15), apply appropriate torque.

4. Sluggish operation.

Possible Causes	Remedies
A. Fluid too viscous.	A. Heat fluid. Contact factory.

5. Excessive pressure downstream.

Possible Causes	Remedies
A. Regulator not closing tightly.	A. Inspect the seating. Clean and lap metal seat surfaces; replace if lapping does not remedy. If composition seats are depressed, nicked or embedded with debris, replace trim.
B. Downstream block.	B. Check system; isolate (block) flow at regulator inlet - not outlet. Relocate regulator if necessary.
C. No pressure relief protection.	C. Install safety relief valve, or rupture disc.
D. Restricted diaphragm movement.	D. Assure no moisture in spring chamber at temperatures below freeze point. Assure no dust or debris entering vent opening. If rainwater or debris can enter, re-orient regulator.

SECTION VIII

VIII. ORDERING INFORMATION
NEW REPLACEMENT UNIT vs PARTS "KIT" FOR FIELD REPAIR

To obtain a quotation or place an order, please retrieve the Serial Number and Product Code that was stamped on the metal name plate and attached to the unit. This information can also be found on the Bill of Material ("BOM") a parts list that was provided when unit was originally shipped. (Serial Number typically 6 digits). Product Code typical format as follows: (last digit is alpha character that reflects revision level for the product).

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NEW REPLACEMENT UNIT:

Contact your local Cashco, Inc., Sales Representative with the Serial Number and Product code. With this information they can provide a quotation for a new unit including a complete description, price and availability.

⚠ CAUTION

Do not attempt to alter the original construction of any unit without assistance and approval from the factory. All purposed changes will require a new name plate with appropriate ratings and new product code to accommodate the recommended part(s) changes.

PARTS "KIT" for FIELD REPAIR:

Contact your local Cashco, Inc., Sales Representative with the Serial Number and Product code. Identify the parts and the quantity required to repair the unit from the "BOM" sheet that was provided when unit was originally shipped.

NOTE: *Those part numbers that have a quantity indicated under "Spare Parts" in column "A" reflect minimum parts required for inspection and rebuild, - "Soft Goods Kit". Those in column "B" include minimum trim replacement parts needed plus those "Soft Goods" parts from column "A".*

If the "BOM" is not available, refer to the cross-sectional drawings included in this manual for part identification and selection.

A Local Sales Representative will provide quotation for appropriate Kit Number, Price and Availability.

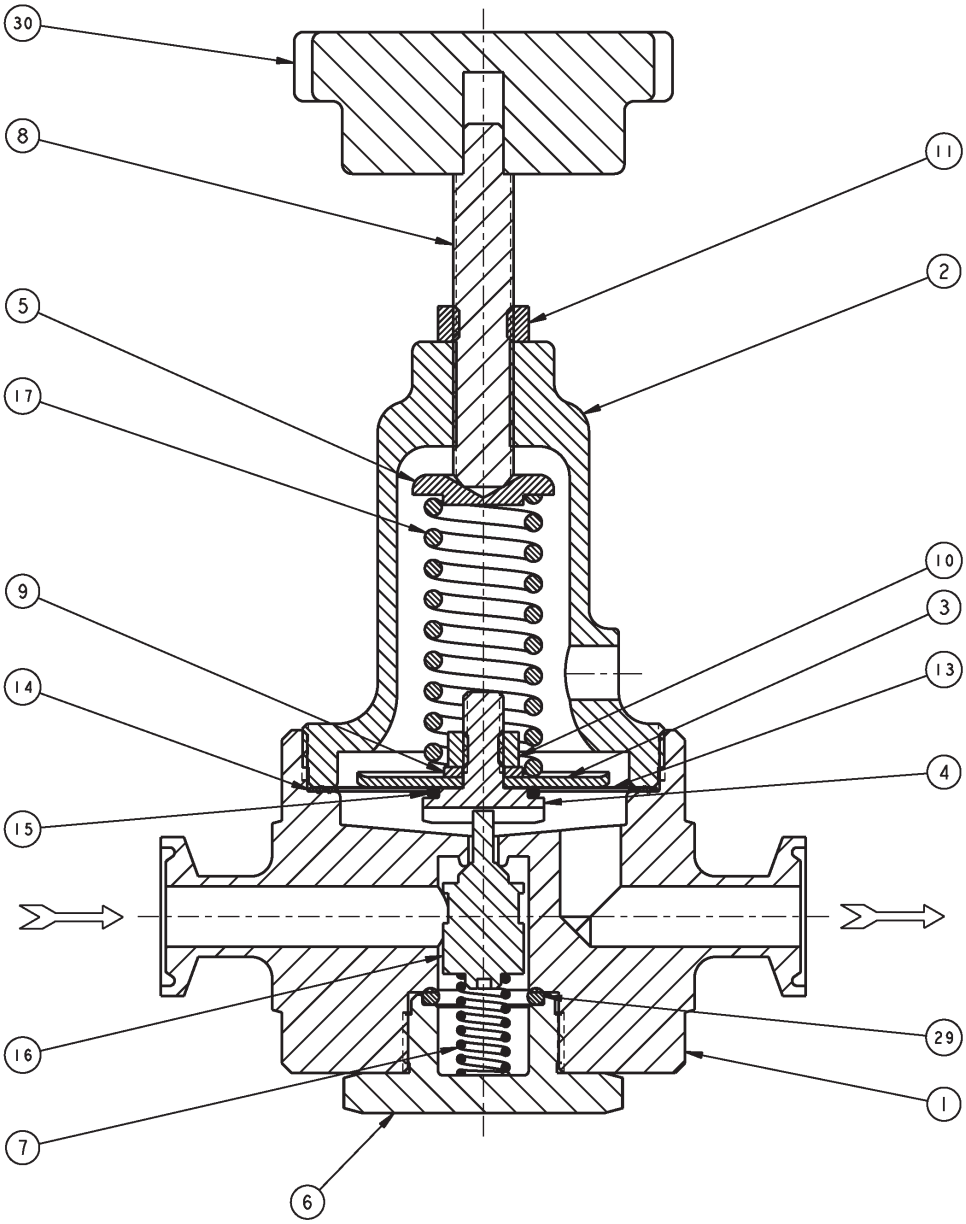

Figure 2: Basic Model 5381, Metal Seat Design

Item No.	Description	Repair Kit B
1	Body	
2	Spring Chamber	
3	Pressure Plate	
4	Pusher Plate	
5	Spring Button	
6	Body Cap	
7	Piston Spring	‡‡
8	Adjusting Screw	
9	Lock Washer	
10	Pressure Plate Nut	
11	Adjusting Screw Locknut	
13	Diaphragm(s)	‡‡
14	Diaphragm Gasket	‡‡
15	Pusher Plate O-ring	‡‡
16	Piston & Piston Subassy.	‡‡
17	Range Spring	
29	Body Cap O-ring	‡‡
30	Adjusting Knob	

‡‡ **Recommended Spare Part**

IOM ADDENDUM:

ATEX DIRECTIVE 2014/34/EU and THE EQUIPMENT AND PROTECTIVE SYSTEMS INTENDED FOR USE IN POTENTIALLY EXPLOSIVE ATMOSPHERES REGULATIONS 2016

Cashco, Inc. declares that the products listed in the table below has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of products intended for use in potentially explosive atmospheres given in Annex II of the ATEX Directive 2014/34/EU and given in Schedule 1 of The Equipment and Protective Systems Indented for Use in Potentially Explosive Atmospheres Regulations 2016. Compliance with the Essential Health and Safety Requirements has been assured by compliance with EN ISO 80079-36:2016 and EN ISO 80079-37:2016. The product will be marked as follows:

II 2 G
Ex h IIB T6... T1 Gb
1000ATEXR1 X

The 'X' placed after the technical file number indicates that the product is subject to specific conditions of use as follows:

1. The maximum surface temperature depends entirely on the operating conditions and not the equipment itself. The combination of the maximum ambient and the maximum process medium temperature shall be used to determine the maximum surface temperature and corresponding temperature classification, considering the safety margins described prescribed in EN ISO 80079-36:2016, Clause 8.2. Additionally, the system designer and users must take precautions to prevent rapid system pressurization which may raise the surface temperature of system components and tubing due to adiabatic compression of the system gas. Furthermore, the Joule-Thomson effect may cause process gases to rise in temperature as they expand going through a regulator. This could raise the external surface temperature of the regulator body and the downstream piping creating a potential source of ignition. Whether the Joule-Thomson effect leads to heating or cooling of the process gas depends on the process gas and the inlet and outlet pressures. The system designer is responsible for determining whether the process gas temperature may raise under any operating conditions.

2. Where the process medium is a liquid or semi-solid material with a surface resistance in excess of 1GΩ, special precautions shall be taken to ensure the process does not generate electrostatic discharge.

3. Special consideration shall be made regarding the filtration of the process medium if there is a potential for the process medium to contain solid particles. Where particles are present, the process flow shall be <1m/s (<3.3 ft/s) in order to prevent friction between the process medium and internal surfaces.

4. Effective earthing (grounding) of the product shall be ensured during installation.

5. The valve body/housing shall be regularly cleaned to prevent build up of dust deposits.

6. Regulators must be ordered with the non-relieving option (instead of the self-relieving option) if the process gas they are to be used with is hazardous (flammable, toxic, etc.). The self-relieving option vents process gas through the regulator cap directly into the atmosphere while the non-relieving option does not. Using regulators with the self-relieving option in a flammable gas system could create an explosive atmosphere in the vicinity of the regulator.

7. Tied diaphragm regulators with outlet ranges greater than 7 barg (100 psig) should be preset to minimize the risk that improper operation might lead to an outboard leak and a potentially explosive atmosphere.

8. All equipment must only be fitted with manufacturer's original spare parts.

9. Ensure that only non-sparking tools are used, as per EN 1127-1, Annex A.

	PRODUCT
REGULATORS	31-B, 31-N
	1164, 1164(OPT-45)
	1171, 1171(OPT-45), 1171(CRYO)
	2171, 2171(OPT-45), 2171(CRYO), 3171
	1465, 3381, 3381(OPT-45), 3381(OPT-40)
	4381, 4381(OPT-37), 4381(CRYO), 4381(OPT-45), 5381
	MPRV-H, MPRV-L
	PBE, PBE-L, PBE-H
	CA-1, CA-2
	CA1, SA1, CA4, SA4, CA5, SA5
	DA2, DA4, DA5, DA6, DA8
	DA0, DA1, DAP, SAP
	SLR-1, SLR-2, PTR-1
	ALR-1, ULR-1, PGR-1
	BQ, BQ(OPT-45), BQ(CRYO)
	123, 123(CRYO), 123(OPT-45), 123(OPT-46G)
	123-1+6, 123-1+6(OPT-45), 123-1+6(OPT-46G), 123-1+6+S, 123-1+6+S(OPT-40)
	1000HP, 1000HP(OPT-37), 1000HP(OPT-45), 1000HP(OPT-45G), 1000HP(CRYO)
	1000HP-1+6, 1000HP-1+8, 1000LP, 1000LP(OPT-45), 1000LP(OPT-46G)
	6987
	8310HP, 8310HP-1+6, 8310HP-1+8, 8310LP, 8311HP, 8311LP
	345, 345(OPT-45)
	BA1/BL1, PA1/PL1
	C-BPV, C-PRV, C-CS
	D, D(CRYO), D(OPT-37), D(OPT-20), D(OPT-45)
	DL, DL(LCC), DL(OPT-45)
	BR, BR(CRYO)
	HP, HP(LCC), HP(OPT-45), HP(OPT46G), HP-1+6+S(OPT-40), HP-1+6+S
	P1, P2, P3, P4, P5, P7
	B2, B7
	POSR-1, POSR-2
	5200P, 5300P
	135
	NW-PL, NW-SO
	CG-PILOT
	FG1
CONTROL VALVES	RANGER, 987, PREMIER
	964, 521, 988, 988-MB, 989
	2296/2296HF
	SCV-30, SCV-S
TANK BLANKETING	8700, 8910, 8920, 8930, 8940
	2100, 2199
	3100, 3200, 3300, 3400, 3500, 3600, 3700
	1078, 1088, 1100, 1049
	5100, 5200, 5400 ,5500
	4100, 4200, 4300, 4400, 4500, 4600
MISC	764P/PD, 764-37, 764T

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