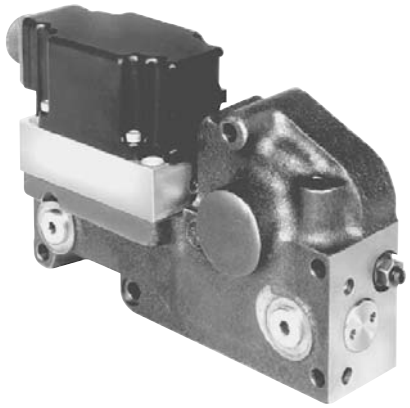
MCV111B
Electrical Displacement Control-PV Series 90

BLN-95-8995-4 **Issued**: September 1996

DESCRIPTION

The MCV111B Electrical Displacement Control (EDC) is a two-stage electrohydraulic pump stroke control which uses mechanical feedback to establish closed loop control of the swashplate angle of Danfoss Series 90 Pumps.

The first stage, the MCV110 Pressure Control Pilot (PCP) is a torque-motor actuated, double-nozzle flapper valve that produces a differential output pressure proportional to the applied electrical signal. The second stage uses the differential pressure to drive its unique spool arrangement and port oil to the pump servo cylinders. The second-stage spool configuration allows a null deadband (for machine safety) in the pump's output while maintaining optimum dynamic response to control commands.



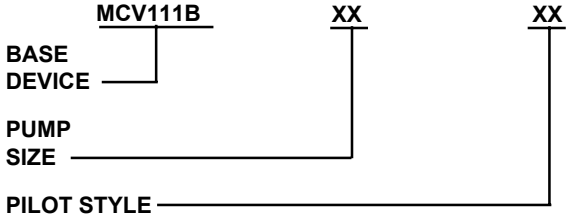
FEATURES

- Servo control deadband independent of signal null deadband: offers safety combined with accurate and responsive control
- Resistance to the environment: standard silicone oil filled torque motor, environmentally sealed first/second stage interface, full environmental testing
- Minimum long term null shift
- Dual coil torque motor can be used to sum two command sources

ORDERING INFORMATION

The MCV111B Electrical Displacement Control is ordered by specifying the pump size and pilot type as shown in Table A. Consult Danfoss, Minneapolis, MN, with further questions.

TABLE A. INFORMATION NECESSARY TO SPECIFY THE EDC.



1. PUMP SIZE

MODEL CODE	PUMP SIZE
03	30 cc
05	42 or 55 cc
07	75 cc
10	100 cc
13	130 cc Pump S/N < 92 - 19
14	130 cc Pump S/N ≥ 92 -19
18/25	180 or 250 cc

2. PILOT

MODEL CODE	PILOT STYLE
02	MS Connector
04	Packard Connector

EDCs ordered separate from the pump must have mounting kits ordered separately:

30/55 cc PUMP KIT (KIT NUMBER KK11655)
Comprised of one K07652 gasket and six 9007314-0611 bolts

75/100/130 cc PUMP KIT (KIT NUMBER KK11675)
Comprised of one K07653 gasket and six 9007314-0611 bolts

42 cc PUMP KIT (KIT NUMBER KK11642)
Comprised of one K07652 gasket, six 9007314-0611 bolts and one K09123 washer

180/250 cc PUMP KIT (KIT NUMBER KK11618)
Comprised of one K07653 gasket, six 9007314-0611 bolts and one K09123 washer

TECHNICAL DATA

ELECTRICAL

FULL STROKE CURRENT
85 ± 11.3 mA (single coil)
42 ± 5.6 mA (series coils)
85 ± 11.3 mA (parallel coils)
See Current vs. Swashplate Angle curve

NOMINAL INPUT IMPEDANCE
24.7 ohms, .093 henries, each coil

DEADBAND
32 ± 7 psi divided by the scale factor

HYDRAULIC

FILTRATION
The system hydraulics must have 10 micron or better filtration. The pump will contain screen filters near the interface to the EDC at the charge port and control port locations. The pilot will have screen filters at its input and output control ports.

FLUID
Automatic transmission fluid or hydraulic oil, such as Mobil DTE 24 or equivalent

OIL VISCOSITY
40-6000 SSU

OIL TEMPERATURE
-40° C (-40° F) minimum; 104° C (220° F) maximum

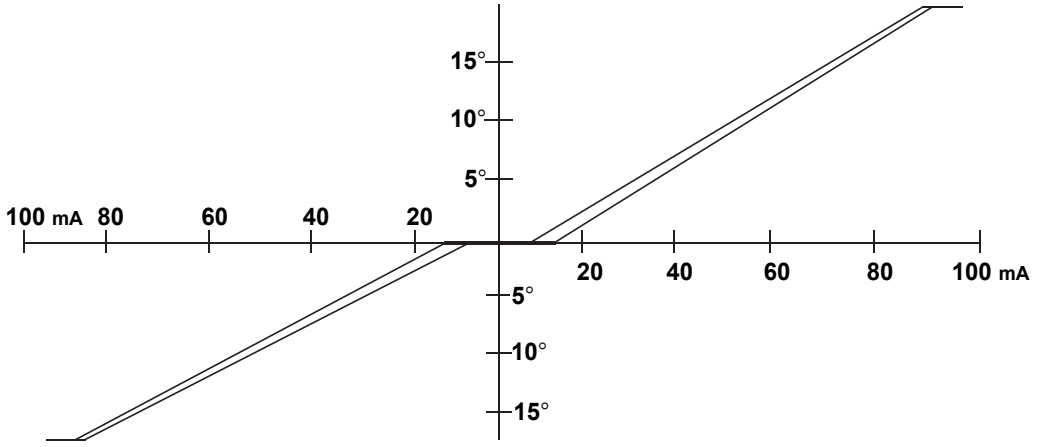
OPERATING SUPPLY PRESSURE
Typically 300-400 psi above case pressure

RATINGS

SCALE FACTOR
1.15 psi/mA (single coil)
2.3 psi/mA (coils in series)
1.15 psi/mA (coils in parallel)

TEMPERATURE
The valve will meet all specifications over the range of 21° to 82° C (70° to 180° F)

CURRENT VS. SWASHPLATE ANGLE

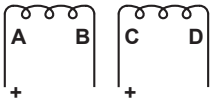
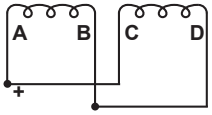
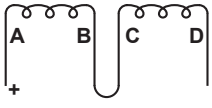


1390

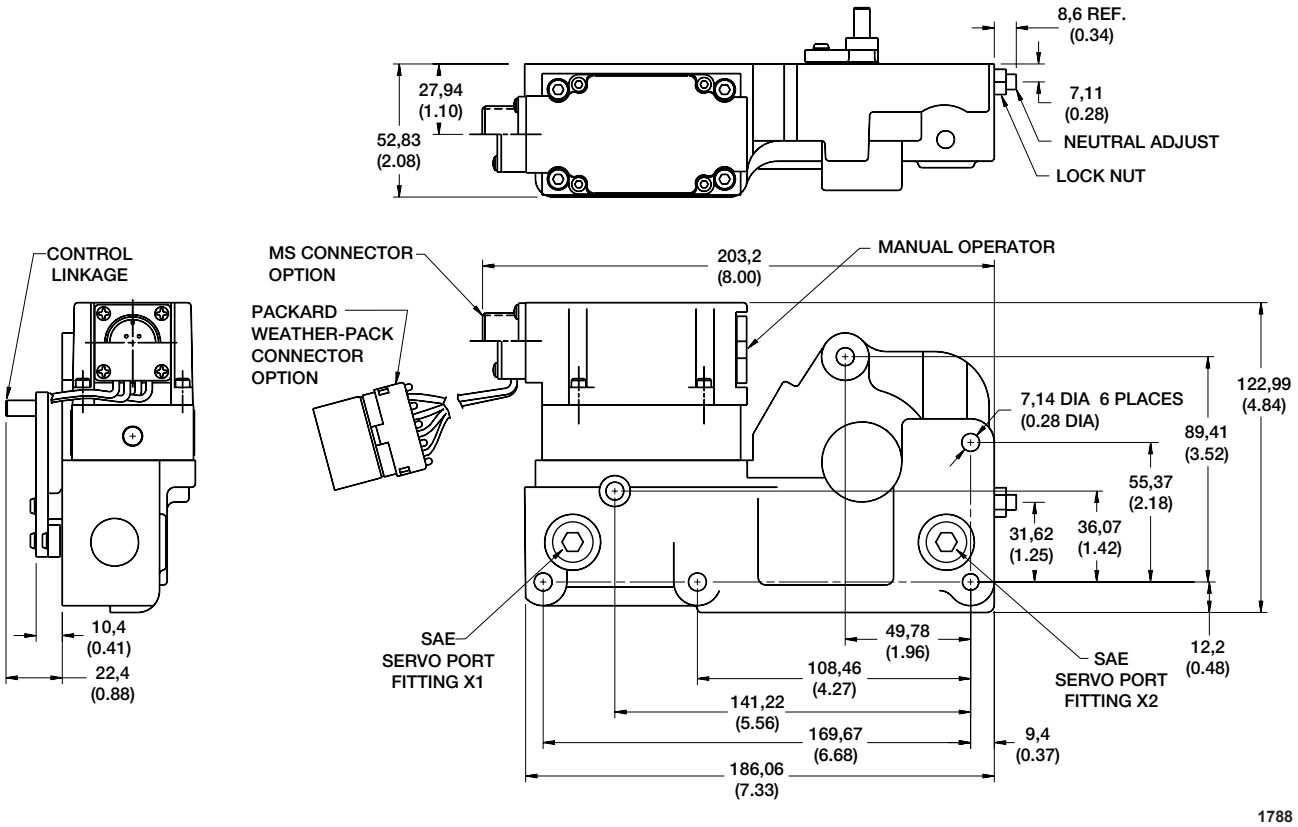
Current Vs. Swashplate Angle of the Single Coil MCV111B.

ELECTRICAL CHARACTERISTICS

INPUT SHAFT ROTATION VS. TERMINAL CONNECTION VS. OUTPUT FLOW

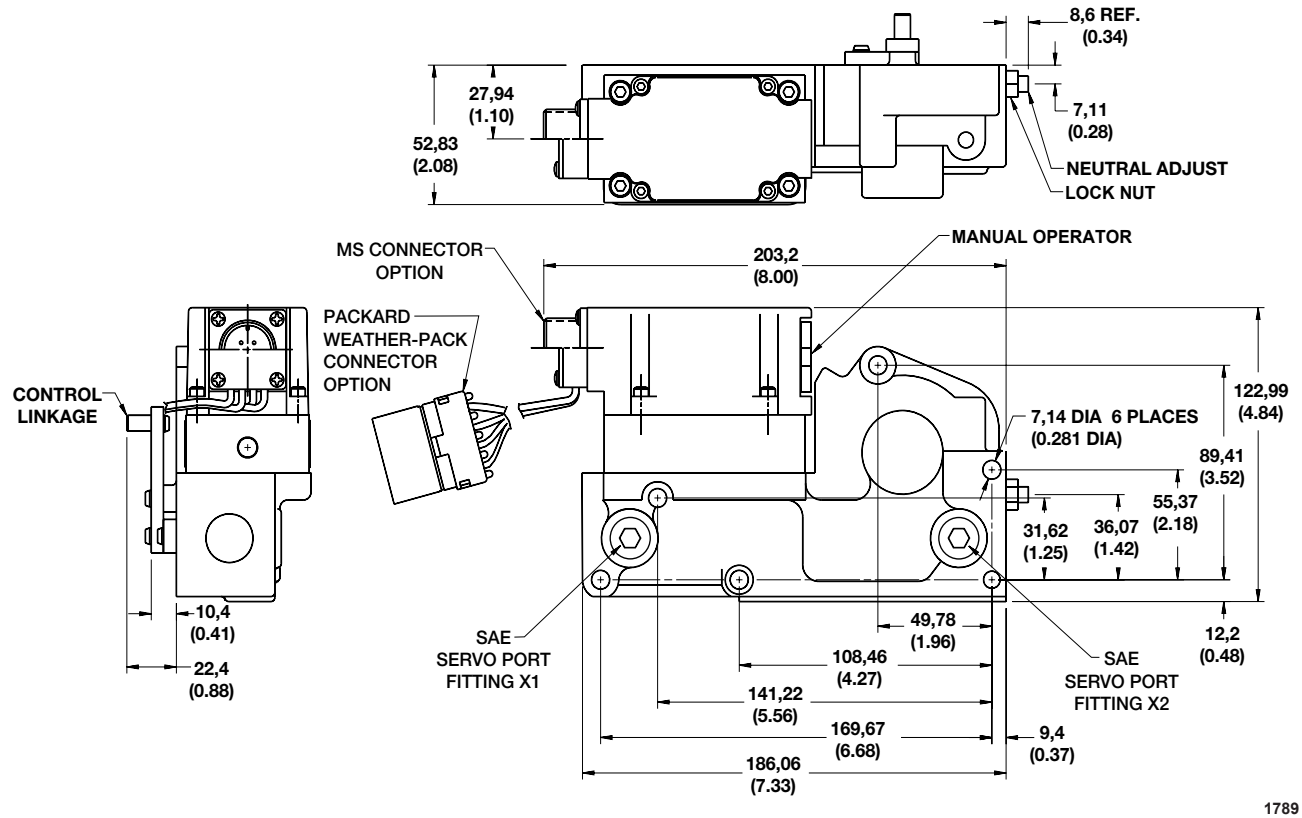
	(+) Voltage to Terminal							
	One of Dual Coils		Dual Coils in Parallel		Dual Coils in Series			
Input Shaft Rotation							Produces Flow Out Of Port	
Clockwise	A or C	B or D	A or C	B or D	A	D	A	B
Counterclockwise	A or C	B or D	A or C	B or D	A	D	B	A
Start Current Full Stroke Current	14 mA with 0.43 Vdc 85 mA with 2.3 Vdc		14 mA with 0.22 Vdc 85 mA with 1.15 Vdc		7 mA with 0.43 Vdc 42 mA with 2.3 Vdc			

DIMENSIONS, 75, 100, 130, 180, AND 250 cc PUMP EDC



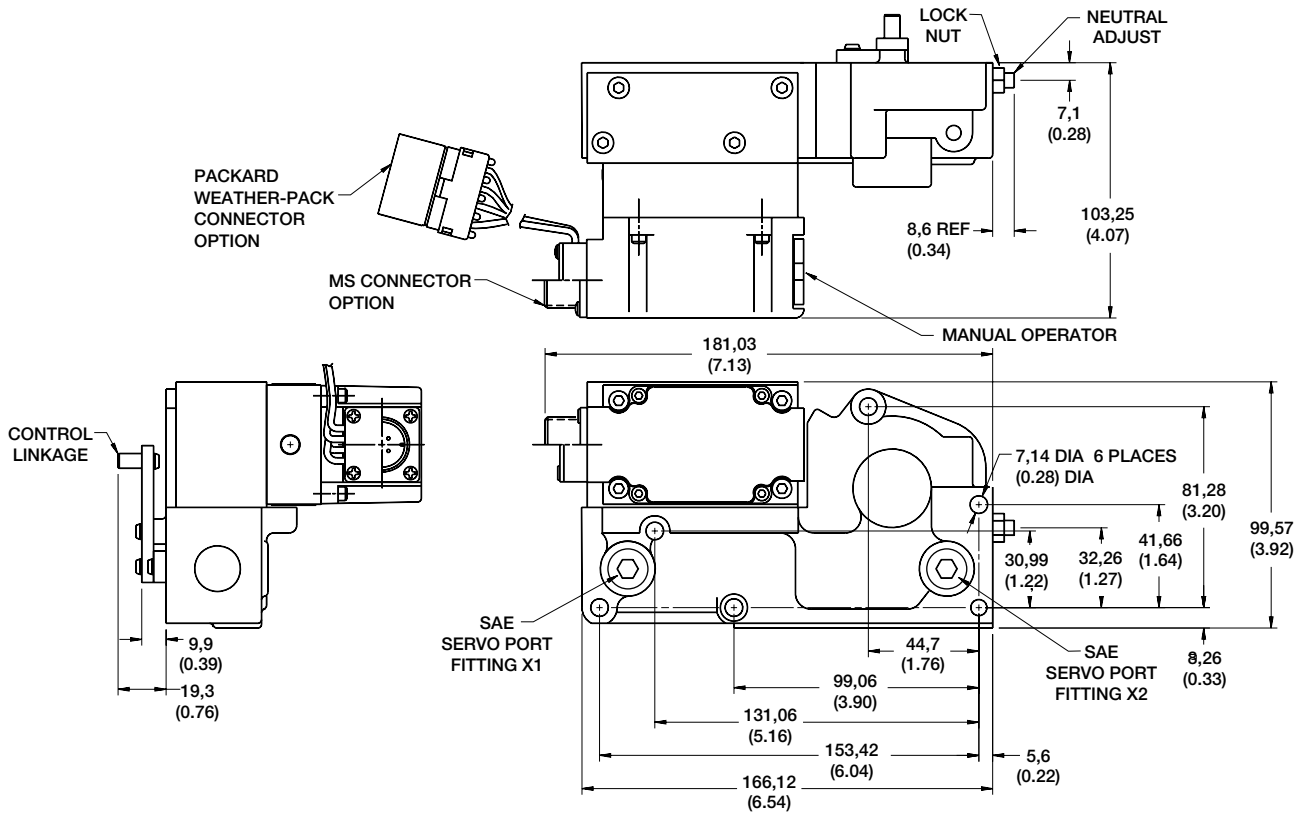
Dimensions of the MCV111B EDC for 75, 100, 130, 180, and 250 cc Pumps in Millimeters (Inches).

DIMENSIONS, 42 cc AND 55 cc PUMP EDC



Dimensions of the MCV111B EDC for 42 cc and 55 cc Pumps in Millimeters (Inches).

DIMENSIONS, 30 cc PUMP EDC



Dimensions of the MCV111B EDC for 30 cc Pumps in Millimeters (Inches).

THEORY OF OPERATION

A command source such as a joystick, control handle or electronic controller applies current signals to the pilot stage of the MCV111B Electrical Displacement Control, which results in flow out of the pump. The input current commands the pilot's torque motor stage, a bridge network consisting of an armature mounted on a torsion pivot and suspended in the air gap of a magnetic field. Two permanent magnets polarized together with two pole pieces form a frame for the magnetic bridge. At null the armature is centered in the air gaps between the magnets' opposing poles by the equivalence of their magnetic forces and the null adjust centering springs. As the input differential current rises to the dual coils, the end of the armature becomes biased either north or south, depending on the magnitude of the current differential. The resulting armature movement is determined by the amperage of control current, the spring constant and the differential pressure feedback forces, explained below. See Internal Workings Schematic.

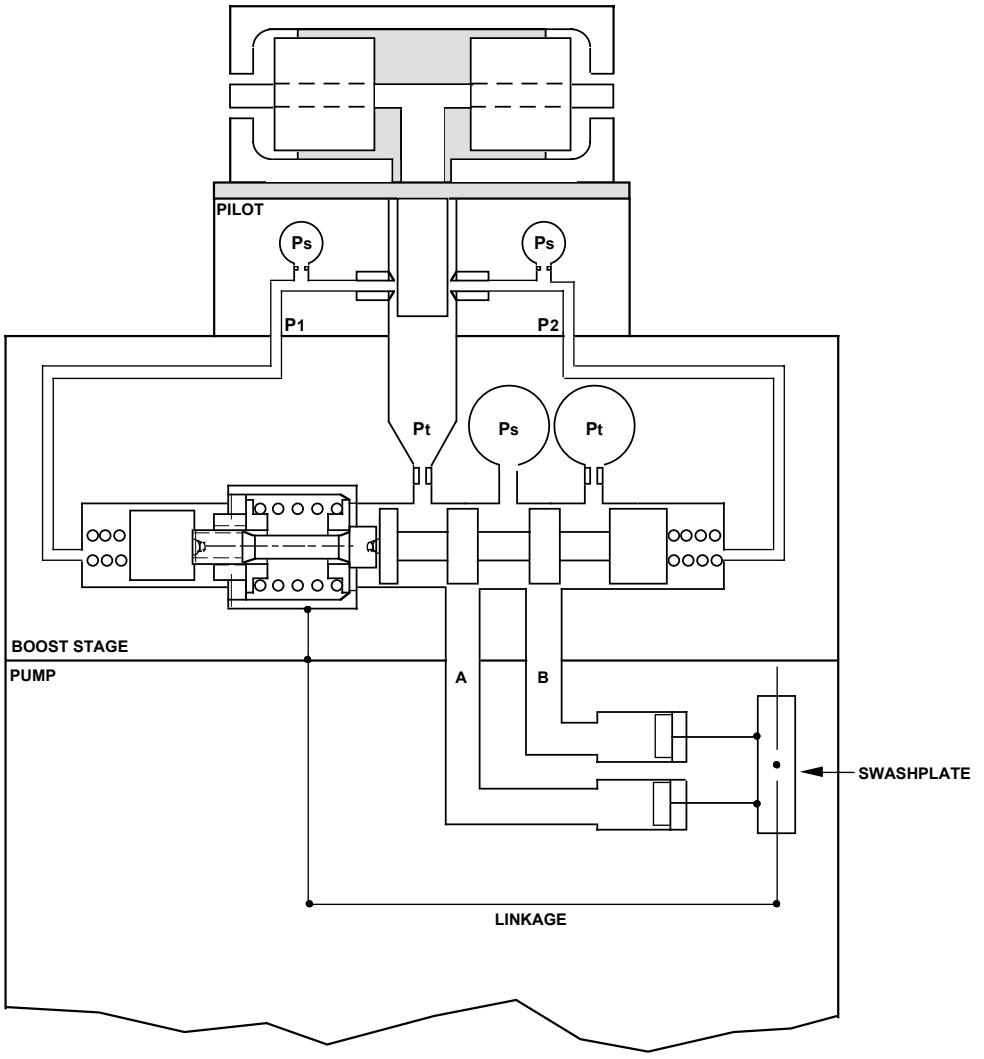
The magnetic bridge output, flapper torque, in turn controls the hydraulic bridge ratio. At null, the flapper is centered between two nozzles. Upstream from each nozzle is an orifice which provides a nominal pressure drop when the system is at null. Between the nozzle and the orifice on each side is a control port. As the torque motor shifts the flapper away from one nozzle toward the other, a differential control pressure results, the high side being the one nearer the flapper. Fluid pressure rises on this side and moves the flapper back towards null. When the torque output from the motor equals the torque output from the pressure feedback, the pilot system is in equilibrium. It is this pressure feedback that makes the pilot a stand-alone closed loop pressure control valve. The pilot stage is silicone oil filled for protection against the environment and for proper valve operation.

The second stage of the EDC uses a unique spool-barrel feedback arrangement that serves to separate the null deadband from the feedback, giving both safety against null drift and quick dynamic response to command changes.

The second stage's null adjust is set with a feedback spring compressed to a 16 psi threshold (measured at the center of the hysteresis loop), which is the amount of differential pressure required to begin to move the actuator spool one direction or the other. The threshold is a factory setting. By tightening or loosening the main null adjust screw, the fixed deadband is adjusted so that the pump starts to stroke with equal output current on either side of null.

As differential control pressure input from the pilot rises beyond the 16 psi deadband, the spool moves in one direction or the other, opening one of the control ports to supply charge pressure to the pump's servo-cylinders, moving the swashplate. As the swashplate moves, the linkage follows, moving the barrel in the opposite direction of the spool's original motion. The barrel's feedback movement tends to drive the spool back toward neutral through its internal feedback spring. Oil returns from the servo cylinders through the spool to the case.

INTERNAL WORKINGS SCHEMATIC



PERFORMANCE

HYSTERESIS

Less than 7 psi divided by the scale factor. Measured at a frequency of .01 Hz at 30% of rated current when run from plus to minus 98 psi divided by the scale factor

SYMMETRY

The differences in the currents to drive to either side of rated output will not exceed 15%

LINEARITY

No point plotted on the current/swashplate angle curve shall fall outside the area defined by a ±10% slope deviation from the scale factor, exclusive of the deadband

FAIL SAFETY

The spool will return to neutral if the electrical signal is disconnected or if the pilot output pressure goes to case pressure. Mechanical feedback must be present.

FREQUENCY RESPONSE
(EXCEPT FOR 130 cc PUMPS)

2 Hz minimum with .052 pressure limiter orifices

3 Hz minimum without pressure limiter orifices (with pressure limiters inoperative)

Under 500-1000 psi load at 90° phase lag with 10 mA signal at 45 mA offset

TIME RESPONSE (EXCEPT FOR 130 CC PUMPS)

1.0 seconds (0 to full stroke with .052 pressure limiter orifices)

2.0 seconds (full to full stroke with .052 pressure limiter orifices)

.30 seconds (0 to full stroke without pressure limiter orifices)

.40 seconds (full to full stroke without pressure limiter orifices)

under 500-1000 load conditions

SENSITIVITY

The valve will respond to a 2% change in input current throughout the rated current range except for the deadband region

DIMENSIONS

See the Dimension drawings

ENVIRONMENTAL

SHOCK

50 g's for 11 milliseconds. Three shocks in both directions of the three mutually perpendicular axes for a total of 18 shocks

VIBRATION

Withstands a vibration test designed for mobile equipment control consisting of two parts:

1. Cycling from 5 to 2000 Hz in each of the three axes
2. Resonance dwell for one million cycles for each resonance point in each of the three axes

Subject to acceleration levels of 1 g to 46 g's

Acceleration level varies with frequency

HUMIDITY

After being placed in a controlled atmosphere of 95% humidity at 49° C (120° F) for 10 days, the EDC will perform within specification limits.

Meets MIL-STD-810B

WIRING

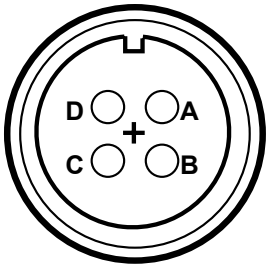
Two wiring styles are available: MS and Packard Weather-Pack. The MS Connector (MS3102C14S-2P) has four pins. See the MS Connector Diagram for pin locations. (Note: The device MS connector is not field replaceable.) See the Electrical Characteristics section for pump phasing.

Mating connectors must be ordered separately. For the MS connector order part number K08106. The mating Packard connector is a bag assembly part number K03384, comprised of :

1. 4, 14-16 gauge sleeves
2. 4, 18-20 gauge sleeves
3. 1 plastic housing
4. 4 green cable seals (accept 2, 2-2, 8 mm wire diameter)
5. 4 gray cable seals (accept 2, 81-3, 49 mm wire diameter)
6. 4 blue cable seals (accept 3, 50-4, 21 mm wire diameter)

See Ordering Information.

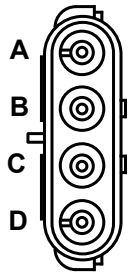
MS CONNECTOR



1276

Pin Orientation of the Optional MS Connector. This Part is not Field Replaceable.

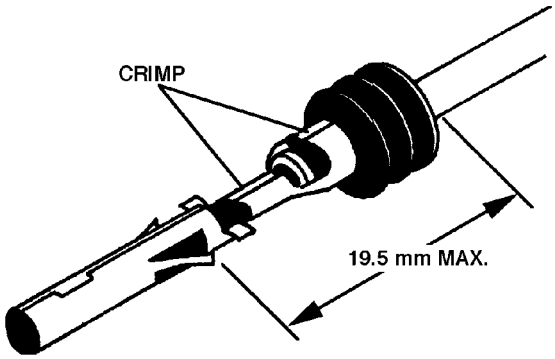
PACKARD CONNECTOR



1622

Pin orientation of the optional Packard Weather-Pack connector. Part number K03384.

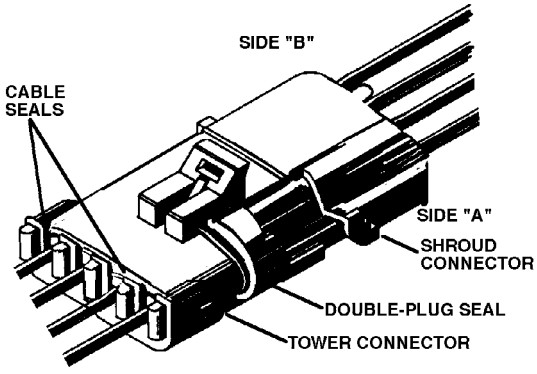
PACKARD CONNECTOR CRIMP



1077

Crimp Location and Distance from Tang to Third Rib of Packard Weather-Pack Connector.

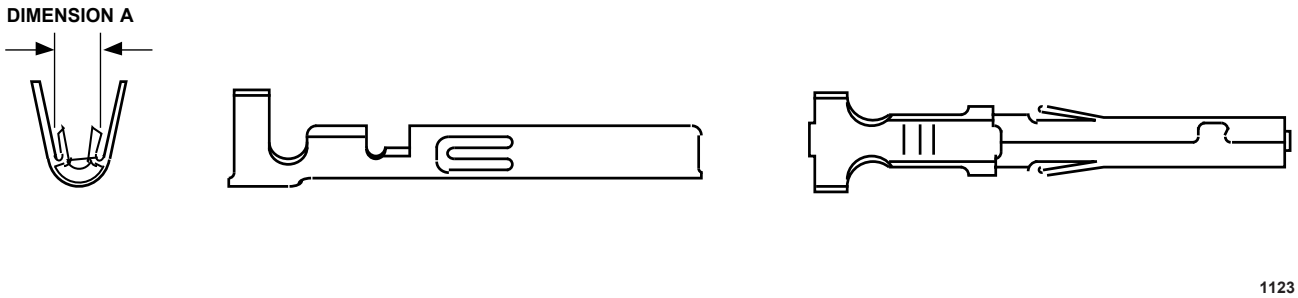
PACKARD CONNECTOR PARTS



1792

Packard Weather-Pack Interlocked Connector Halves with Parts Identified.

DIMENSION A



Dimension A for Selecting Correct Terminal.

WIRING *(continued)*

TO ASSEMBLE THE FEMALE TOWER CONNECTOR

1. Isolate the wires that extend from the command source to the EDC.

2. Strip back the insulation 5,5 millimeters on both wires.

3. Push a ribbed cable seal over each of the wires with the smaller diameter shoulder of the seals toward the wire tip. Select the pair of seals that fits tightly over the wires. The distance from the tip of the wires of the first (nearest) rib should be 9.5 millimeters. Thus the insulation should just protrude beyond the seal.

4. Select the larger of the two sets of pins, as measured at Dimension A (see the Dimension A drawing), if using 14-16 gauge wire. Choose the smaller if using 18-20 gauge. Place the wire into the socket so that the seal edge is pushed through and extends slightly beyond the circular tabs that hold it in place. Crimp in the locations shown in the Packard Connector Crimp drawing with a Packard 12014254 crimp tool. The distance from the back of the tangs to the furthest rib may not exceed 19,5 mm.

5. Manually insert the assembled wires into the back end (large hole) of the plastic housing. Push until the wire detents with an audible click, then pull back slightly to ensure proper seating (Observe the proper phasing of the wires when installing: Black wire to “A” hole, Red wire to “B”, Black to “C” and Red to “D”). Terminals may be removed from the connector bodies with a Packard 12014012 removal tool.

6. Swing the holder down into the detented position to trap the wires in the housing. The third rib should be sealed into the housing.

7. Plug the shroud connector from the valve into the tower connector just constructed. They are sealed with a quadruple plug seal over the quadruple barrel of the tower assembly. The two connector halves should detent into each other. See the Packard Connector Parts drawing.

MOUNTING

WARNING

Exercise care when placing the valve on a surface before mounting on a transmission. Dropping or otherwise forcefully setting the valve down may damage the pin.

Before mounting the MCV111B, remove the manual control or the blanking plate that comes with the pump. First thoroughly clean all external surfaces of the pump with steam or solvent. Then remove the six hex head cap screws from the housing using a 5 mm internal hex wrench. Lift the manual control or plate from the pump.

Before the new control is installed it is recommended that a new mounting gasket be installed. If going from a manual control to an EDC the same mounting bolts can be used. If going from a blanking plate to an EDC new mounting bolts are required because of the different lengths. To help avoid a mounting problem it may be necessary to order an EDC mounting kit. See Ordering Information.

WARNING

*The MCV111**B** EDC cannot be hydraulically connected with another device through the servo ports (X1 and X2). Do not disconnect the SAE servo port fittings for this purpose. Doing so may cause the EDC to go on stroke. The fittings are to be used only for troubleshooting purposes. When hydraulic connections are required, such as for a staging function, the MCV111**C** must be used. Also an orifice (Danfoss orifice fitting part number 9002875-0039) must be located in each of the hydraulic connections. See Ames Bulletin No. 9104 for details.*

MOUNTING *(continued)*

TO INSTALL THE NEW CONTROL

1. Place a new gasket on the pump housing. Ensure that the control orifice and spring are in the proper position in the control.

2. Engage the pin on the control linkage in the mating hole in the link attached to the swashplate. To ensure that linkage is engaged before adding mounting bolts simply place a finger under the electrical input connection and lightly lift. If the control moves more than 3/8-inch the pin is not engaged. Try again. See the Control Linkage Assembly photograph.

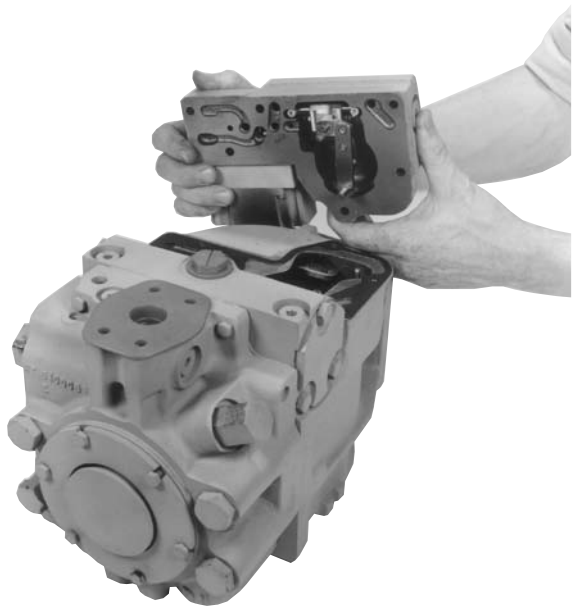
3. Ensure that the pin is engaged in the link by tilting the control upwards from the pilot valve end. If the pin catches in the link and allows only a slight upward tilt, there is positive engagement. If the control swings up freely, the pin is not properly aligned.

WARNING

Ensure positive pin engagement. Failure to do so may result in pump output, and the vehicle may move.

4. Position the control into place against the pump housing. Align the gasket. Install the cap screws (On 42 cc and 180/250 cc pumps use the included seal washer per the Seal Washer Location drawing) and torque to 10-12 ft-lbs.

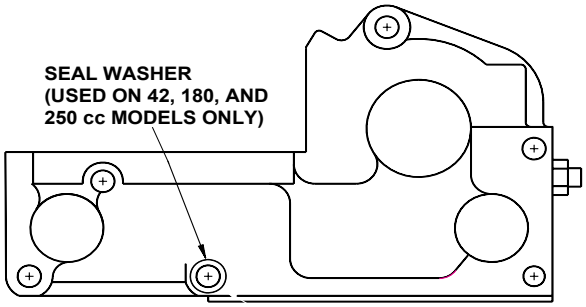
CONTROL LINKAGE ASSEMBLY



1394

Assembly of Control Linkage.

SEAL WASHER LOCATION



1396

Location of Seal Washer on 42, 180, and 250 cc Pump EDCs.

PUMP NEUTRAL ADJUSTMENT

Use the following procedure to bring the pump to neutral once the electrical displacement control has been mounted.

1. Install a 600 psi gauge into the charge pressure gauge port on the pump. See the Pump Port Location photograph.

2. Using a 10 mm wrench, loosen the hex lock nut on the null adjustment screw. See the Dimension drawings.

3. Disconnect the electrical source at the connector.

4. Start the prime mover and run at low idle.

WARNING

To adjust neutral requires operating the pump. Take the necessary safety precautions, such as having unnecessary personnel stand away from the machine. Maximum system pressure may occur upon start-up, and the machine may move. Ensure that the operator is not in a position to be injured should the machine move.

5. Warm the system up for several minutes to bleed air.

6. Slowly increase the prime mover speed to rated rpm.

PUMP NEUTRAL ADJUSTMENT *(continued)*

7. If the transmission operates as indicated by motor shaft rotation, reduce speed to idle. Using a 3 mm internal hex wrench, slowly turn the null adjustment screw clockwise or counterclockwise until the transmission does not operate. Repeat step 6. Note that charge pressure should drop with forward or reverse stroking of the pump swashplate due to the shifting of the shuttle valve in the motor manifold. Slowly turn the null adjustment screw clockwise until charge pressure decreases.

8. With a 3 or 4 mm (4 mm units built after April 95) internal hex wrench, slowly turn the null adjustment screw counterclockwise, observing the wrench angle rotation, until charge pressure decreases again (charge pressure will rise in neutral and drop when going into stroke).

9. Turn the adjustment screw clockwise half the amount of the turn observed in step 8. This should be the center of neutral.

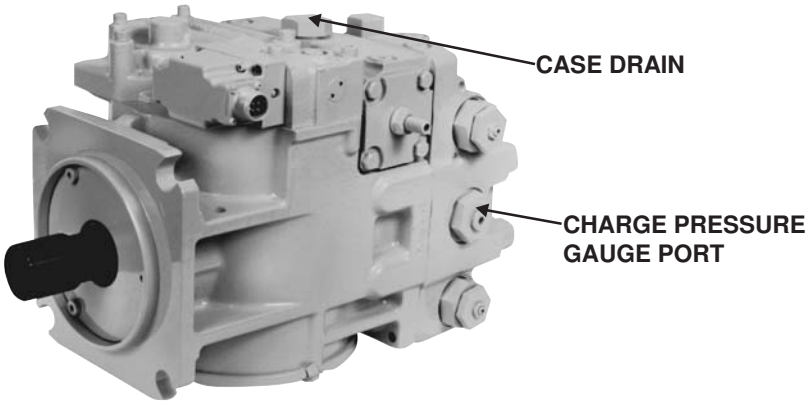
10. Hold the adjustment screw and securely tighten the hex lock nut on the adjustment screw to 14-18 foot-pounds. Note that if a motor is used that does not have a manifold, neutral should be adjusted (steps 8 - 10) by observing the motor shaft rotation without a load.

11. Stop the prime mover.

12. Reconnect the electrical signal source.

13. Run the system briefly to ensure that it operates proportionally on both sides of null. Swashplate movement can be verified by watching motor shaft rotation without a load.

PUMP PORT LOCATION



Location of Pump Ports.

CUSTOMER SERVICE

NORTH AMERICA

ORDER FROM

Danfoss (US) Company
Customer Service Department
3500 Annapolis Lane North
Minneapolis, Minnesota 55447
Phone: (763) 509-2084
Fax: (763) 559-0108

DEVICE REPAIR

For devices in need of repair or evaluation, include a description of the problem and what work you believe needs to be done, along with your name, address and telephone number.

RETURN TO

Danfoss (US) Company
Return Goods Department
3500 Annapolis Lane North
Minneapolis, Minnesota 55447

EUROPE

ORDER FROM

Danfoss (Neumünster) GMBH & Co.
Order Entry Department
Krokamp 35
Postfach 2460
D-24531 Neumünster
Germany
Phone: 49-4321-8710
Fax: 49-4321-871355