

U *SER MANUAL*

Hydraulic Force Control

Manual Number 6096400-R3

cascade[®]
corporation

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HYDRAULIC FORCE CONTROL (HFC)

This manual provides installation instructions, prior to operation, operation, troubleshooting and parts for Cascade Hydraulic Force Control (HFC) systems. If you need additional information or assistance, contact Cascade Corporation. Refer to the back cover.

What The System Does

The HFC system enables Cascade Paper Roll Clamps to automatically apply clamp force proportional to weight of the load. This system will reduce the chance of damage caused by excessive clamp force.

How The System Works

An initial no-slip starting pressure is applied to the load when it is first clamped. As the load is lifted, the HFC system increases clamp force and applies a consistent clamp force proportional to load weight. The hoist system provides pressure to the HFC to increase clamp pressure as hoist pressure increases.

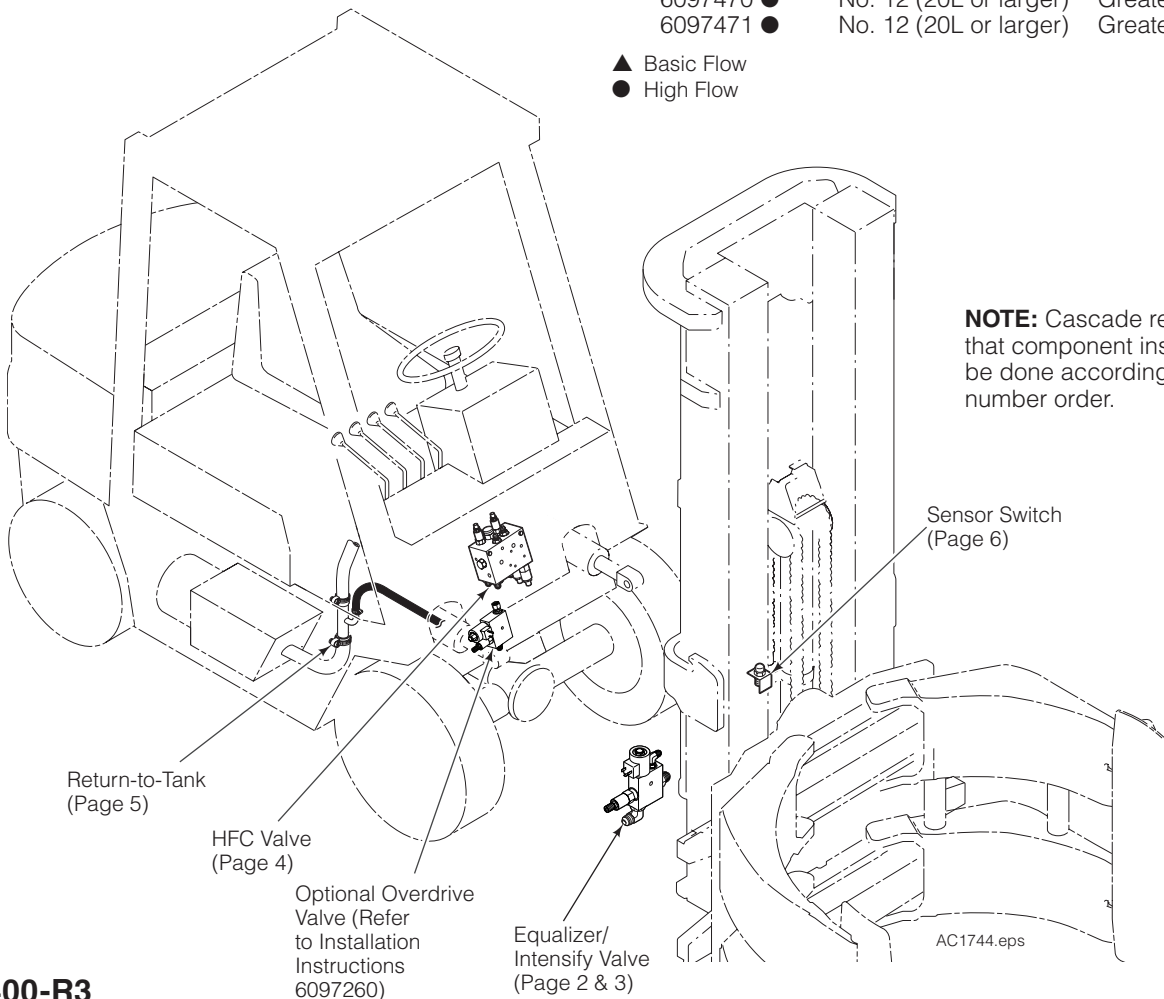
Prior to Installation

The system can be calibrated to balance the clamp force relationship of clamp capacity and truck size. The truck HOIST pressure should be equal to or higher than clamp pressure to properly clamp paper. Total load weight equals paper weight plus clamp weight.

Confirm that the truck size is compatible with the clamp capacity. Available maximum hoist pressure with load weight (combined maximum size load and weight of the clamp) should be determined in freelif. The hoist pressure determined needs to be within 10% of the clamping pressure required to clamp the heaviest load.

HFC Kit (without switch) Part No.	Truck Fitting Size SAE (Metric)	Truck Flow Volume GPM (L/min.)
6097593 ▲	No. 10 (Up to 18L)	18 (68) or less
6093682 ●	No. 12 (20L or larger)	Greater than 18 (68)
HFC Kit (with switch) Part No.	Truck Fitting Size SAE (Metric)	Truck Flow Volume GPM (L/min.)
6096281 ▲	No. 10 (Up to 18L)	18 (68) or less
6096662 ▲	No. 10 (Up to 18L)	18 (68) or less
6097470 ●	No. 12 (20L or larger)	Greater than 18 (68)
6097471 ●	No. 12 (20L or larger)	Greater than 18 (68)

- ▲ Basic Flow
- High Flow



INSTALLATION

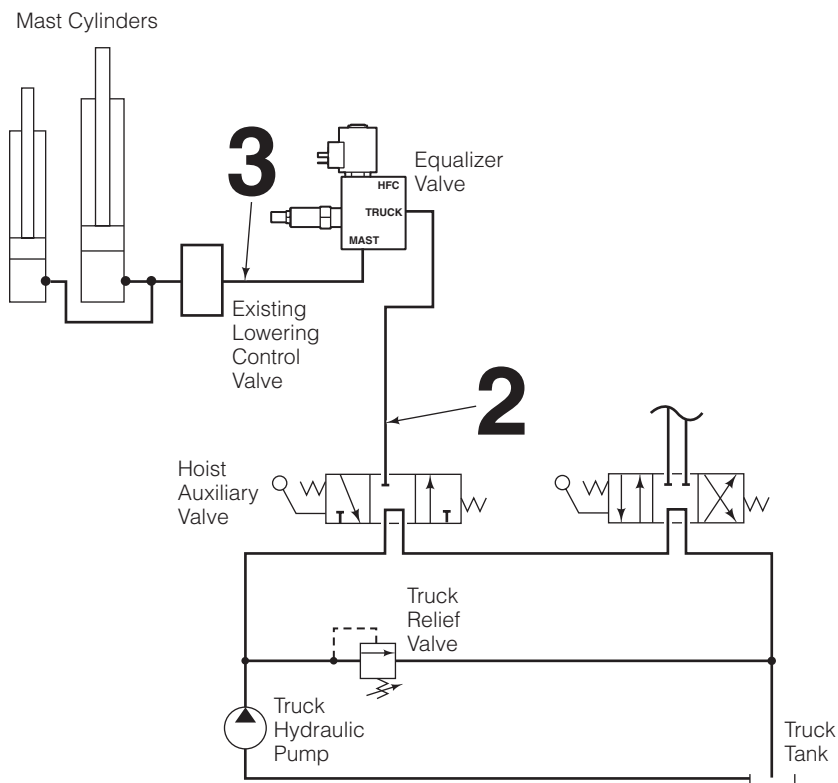
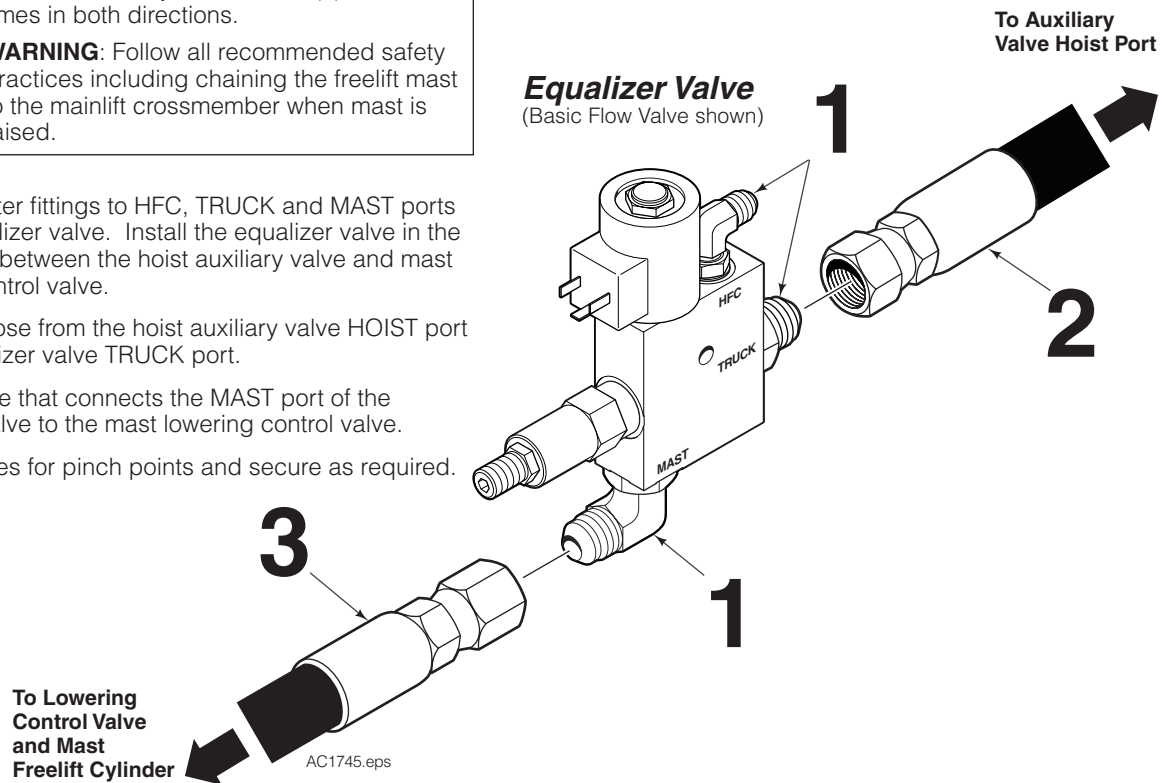
SOLENOID OPERATED EQUALIZER VALVE AND HOSES



WARNING: Before removing hydraulic lines or components, relieve pressure in the hydraulic system. Turn truck off and open the truck auxiliary control valve(s) several times in both directions.

WARNING: Follow all recommended safety practices including chaining the freelift mast to the mainlift crossmember when mast is raised.

- 1 Install adapter fittings to HFC, TRUCK and MAST ports on the equalizer valve. Install the equalizer valve in the hoist circuit between the hoist auxiliary valve and mast lowering control valve.
- 2 Install the hose from the hoist auxiliary valve HOIST port to the equalizer valve TRUCK port.
- 3 Install a hose that connects the MAST port of the equalizer valve to the mast lowering control valve.
- 4 Inspect hoses for pinch points and secure as required.



INSTALLATION

NON-SOLENOID INTENSIFY VALVE AND HOSES

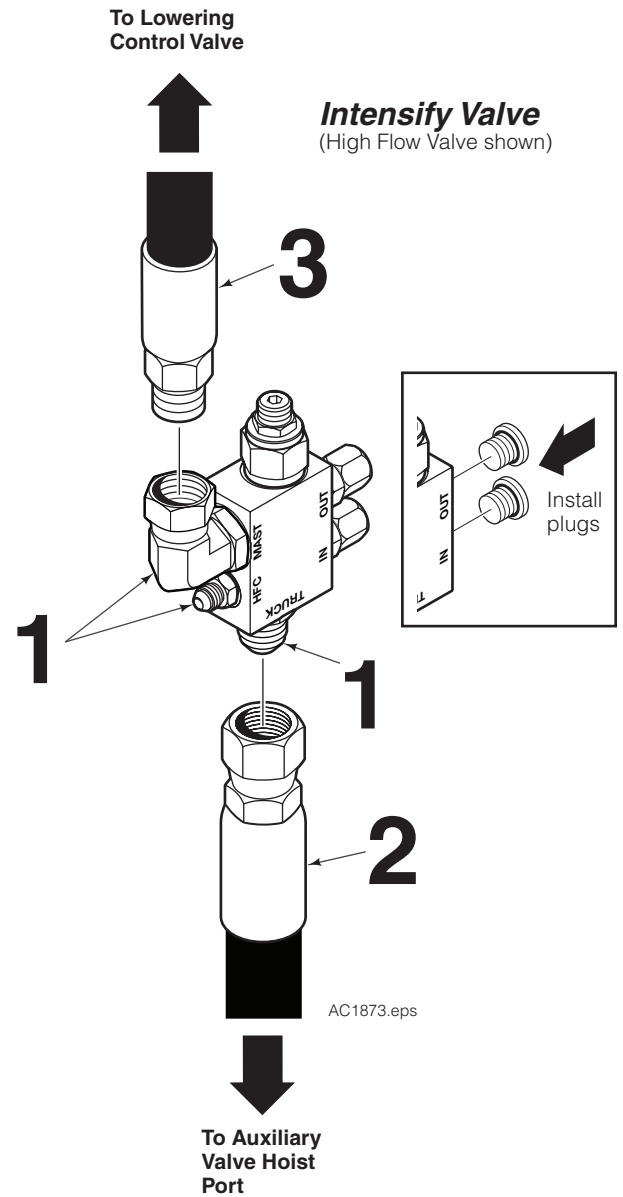
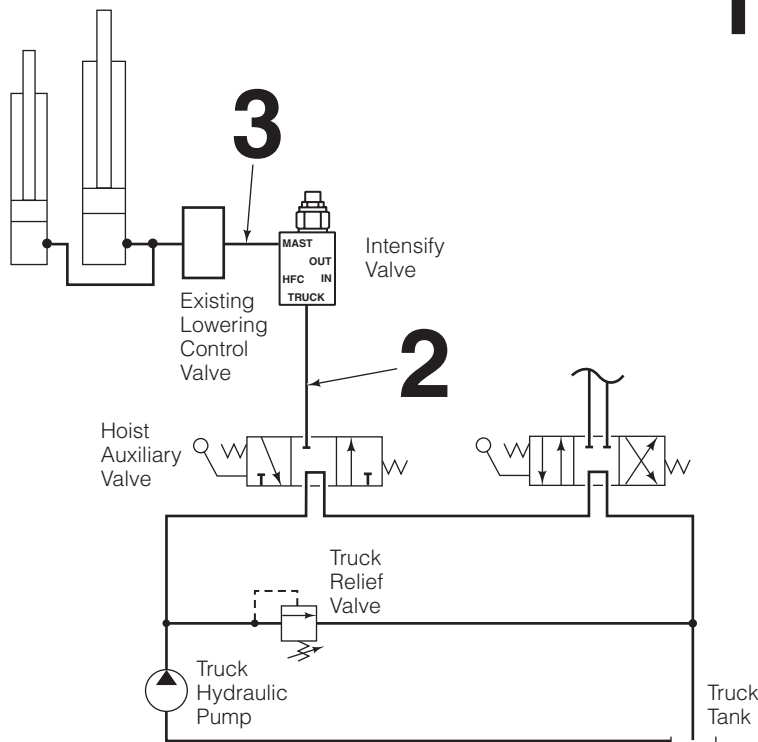


WARNING: Before removing hydraulic lines or components, relieve pressure in the hydraulic system. Turn truck off and open the truck auxiliary control valve(s) several times in both directions.

WARNING: Follow all recommended safety practices including chaining the freelif mast to the mainlift crossmember when mast is raised.

- 1 Install adapter fittings to HFC, TRUCK, and MAST ports. If IN and OUT ports are not plugged, install metal plugs.
- 2 Install the hose from the hoist auxiliary valve HOIST port to the intensify valve TRUCK port.
- 3 Install a hose that connects the MAST port of the intensify valve to the mast lowering control valve.
- 4 Inspect hoses for pinch points and secure as required.

Mast Cylinders

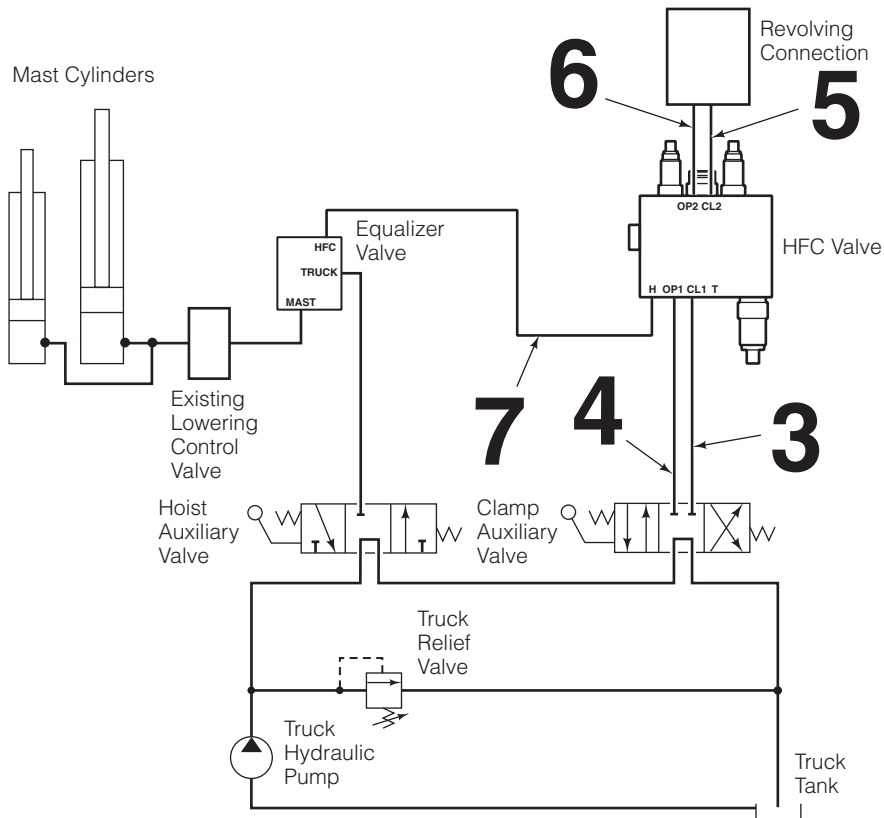
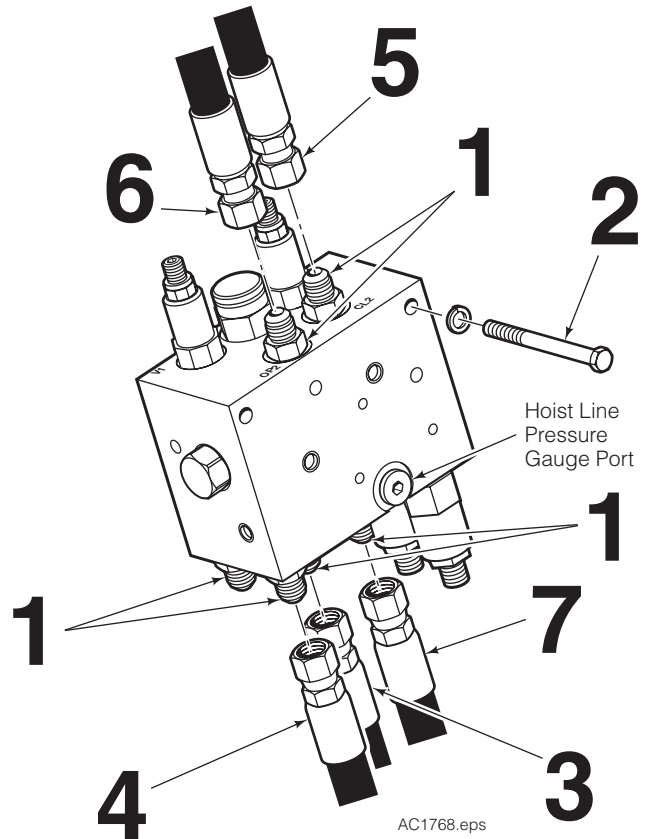


INSTALLATION

HFC VALVE AND HOSES

- 1 Install adapter fittings to T, H, CL1, CL2, OP1 and OP2 ports on the HFC valve.
- 2 Locate and install the HFC valve on the truck cowl using 5/16 in. (8 mm) capscrews. Watch for clearance when the mast is tilted back. The HFC valve cartridges have adjustment screws that will need to be easily accessed.
- 3 Connect a No. 6 (minimum) hose from the truck auxiliary clamp circuit CLAMP port to the CL1 port of the HFC valve.
- 4 Connect a No. 6 (minimum) hose from the truck auxiliary valve clamp circuit OPEN port to the OP1 port of the HFC valve.
- 5 Connect a No. 6 (minimum) hose from the CL2 port of the HFC valve to the attachment revolving connection CLAMP port supply circuit.
- 6 Connect a No. 6 (minimum) hose from the OP2 port of the HFC valve to the attachment revolving connection OPEN port supply circuit.
- 7 Connect a No. 6 (minimum) hose from the H port of the HFC valve to the HFC port of the equalizer valve.
- 8 Inspect hoses for pinch points and secure as required.

HFC Valve



INSTALLATION

RETURN-TO-TANK & OPTIONAL OVERDRIVE VALVE

- 1 Install a return-to-tank fitting in the tank line. Lube hose ends and fitting for easy assembly. For complete installation procedure, refer to Installation Instructions 211744. Cascade Low Pressure Return Line Adapter Kits are as follows:

Tank Hose ID	Single Line Adapter Kit	Dual Line Adapter Kit
.75 in. (19 mm)	214062	6049380
1.00 in. (25 mm)	211745	6049381
1.25 in. (31 mm)	214066	6049382
1.50 in. (38 mm)	6037507	6049383

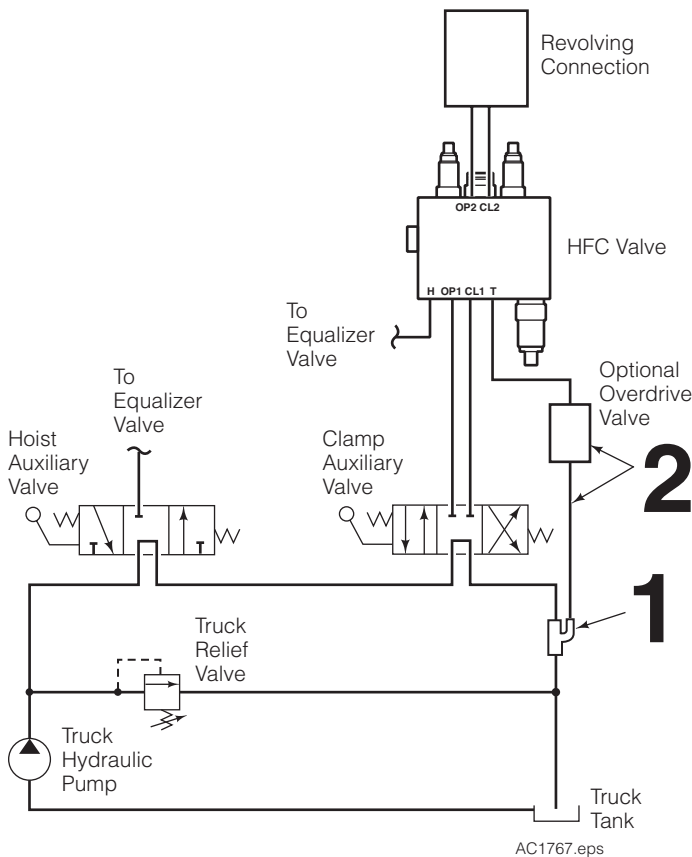
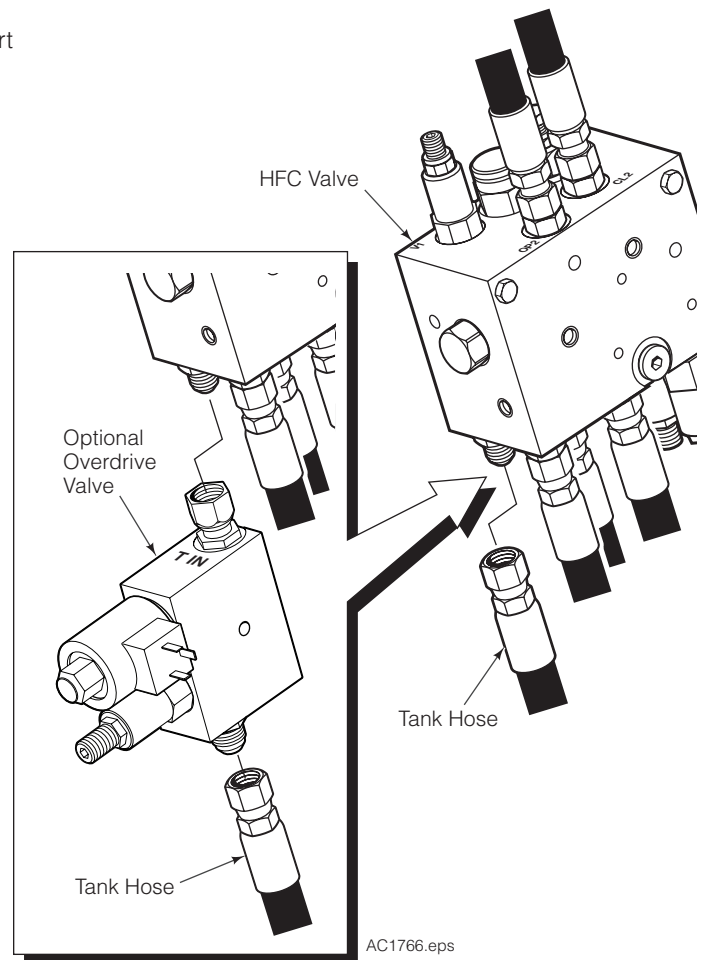
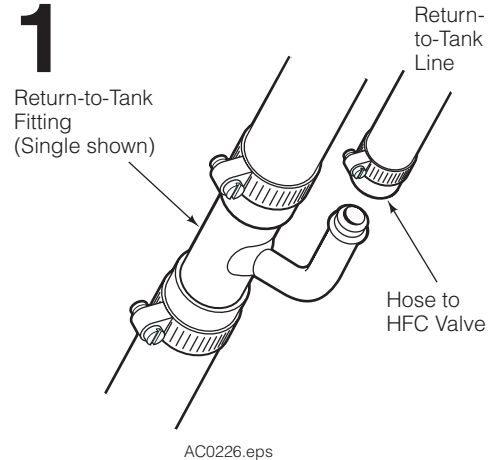
NOTE: For trucks with pressurized return-to-tank lines, the hydraulic tank filler cap must be opened to relieve trapped pressure.

- 2 **No Overdrive Valve** – Connect the T port on the bottom of the HFC Valve to the truck tank line fitting.

Overdrive Valve – Connect the overdrive valve T IN port with the HFC valve T port. Connect a hose from the overdrive valve T OUT port to the truck tank line fitting. Refer to installation instructions 6097260 for additional information.

CAUTION: If the overdrive valve is not directly installed to the HFC valve T port, a high pressure hose must be used. High pressure hose must be rated for 2300 psi (160 bar) working pressure.

- 3 Inspect hose for pinch points and secure as required.



INSTALLATION

SENSOR SWITCH (IF EQUIPPED)

- 1 Determine locations to mount the sensor switch on a fixed location on the mast and the bracket with spring wire (if needed) on a moving member on the mast. The sensor switch will signal the mast transition from freelift to mainlift. The provided mounting bracket can be used or modified to aid with mounting the sensor switch.

CAUTION: Consult the Lift Truck OEM for proper + power source connection.

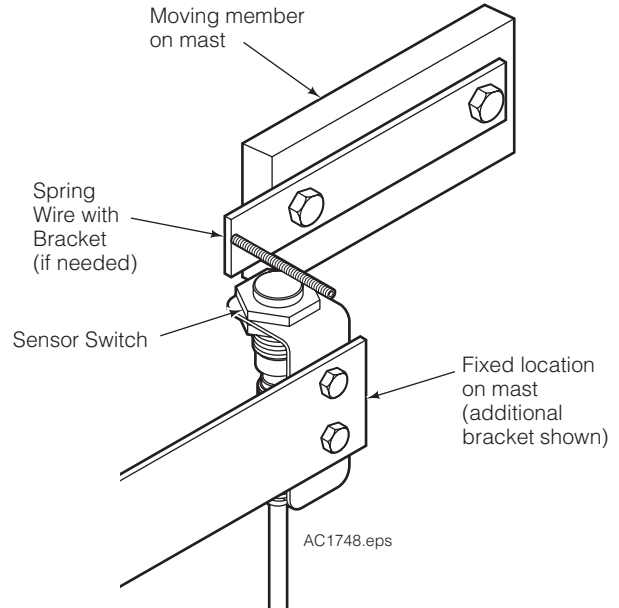
- 2 Connect the harness solenoid connector to the solenoid coil.
- 3 Connect the harness sensor switch connector to the sensor switch.
- 4 Connect the harness cable ends to the components shown.

12V Systems – Connect the fused positive wire from the cable harness to a switched power source and the ground wire to a chassis ground.

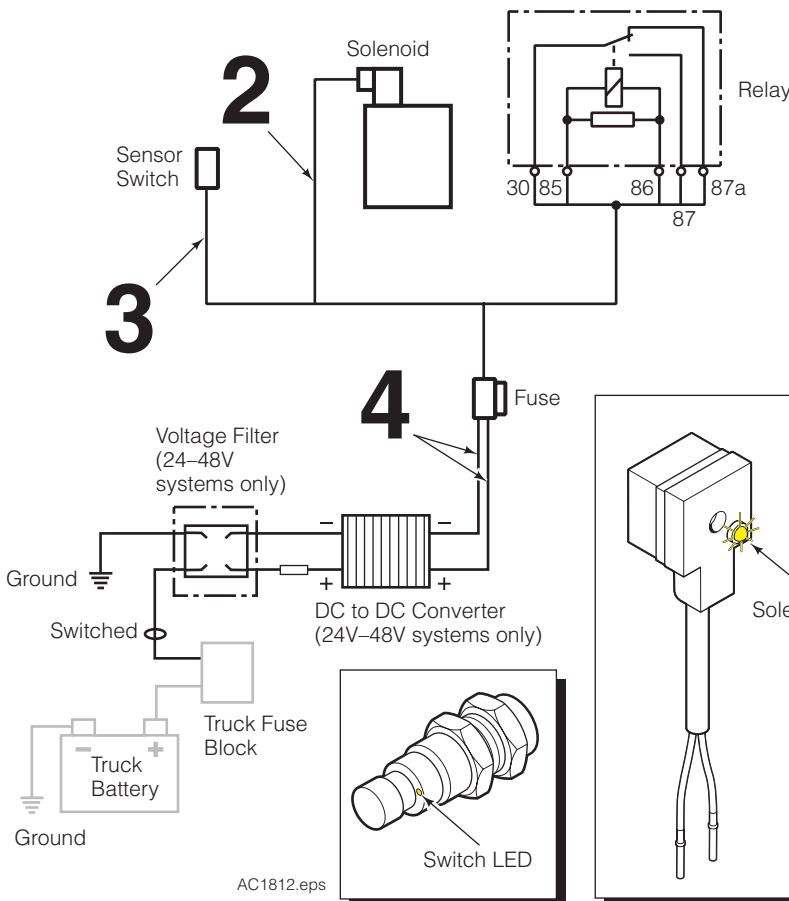
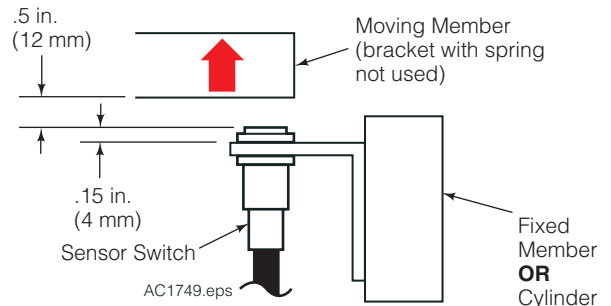
24V–48V Systems – Connect the fused positive wire from the cable harness to a DC-to-DC converter positive output wire and the ground wire to the converter negative output wire. Connect a 24V–48V switched power source to the converter fused positive input wire and connect the converter input ground wire to a chassis ground.

NOTE: For troubleshooting the wire harness, verify that the sensor switch, solenoid and relay are working properly. Check the LEDs on the sensor switch and solenoid. When the mast is in freelift, the LEDs will illuminate and when in mainlift, the LEDs will be off. Check current flow in and out of relay.

NOTE: When installing on electric trucks with regenerative braking, voltage filter 6061953 must be installed. Failure to install voltage filter can cause damage to electrical components.



OR



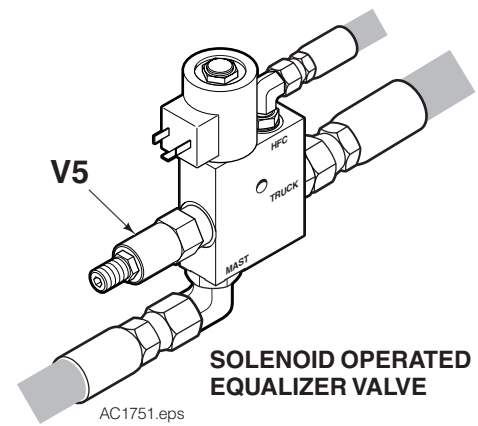
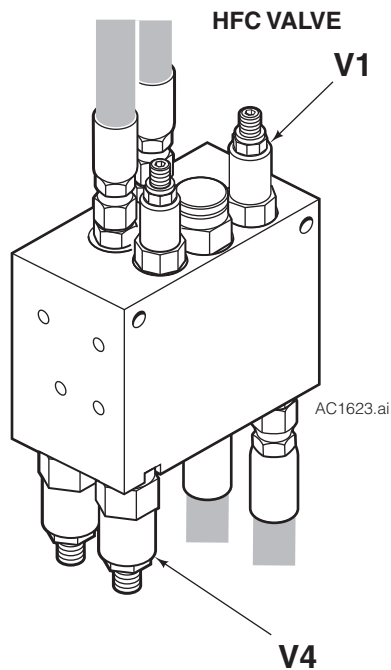
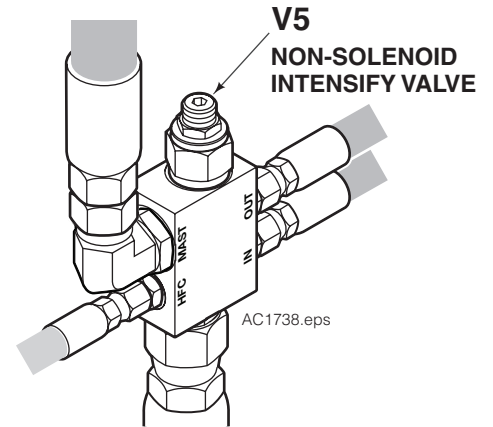
INSTALLATION

DISABLING HFC SYSTEM

To temporarily disable the HFC features, perform the following steps:

- 1 Turn V1 inward (CW) or until desired clamp pressure is reached. The maximum pressure that the cartridge is capable of handling is 3000 psi (207 bar).
- 2 Turn V4 all the way out (CCW).
- 3 **OPTIONAL:** If the hoist capacity is affected by lifting a load, turn V5 all the way out (CCW).
- 4 The truck attachment will now operate in the standard mode.

NOTE: To enable HFC features refer to Prior To Operation Section.



CARTRIDGE FUNCTION SUMMARY

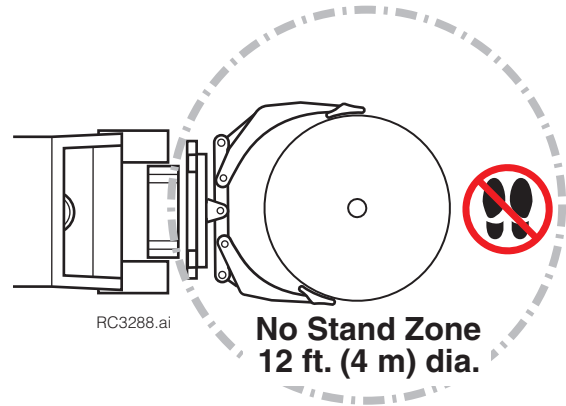
Starting Pressure (V1) – Sets starting pressure.

Final Pressure (V2) – Adjusts clamping pressure after hoisting. Must be adjusted **after** all other cartridges are set.

Static Hoist Pressure (V3) – Closes connection from hoist line to clamp line.

Freelift Pressure (V4) – Limits maximum clamping pressure. Must not be set lower than pressure needed to handle maximum roll.

Mainlift Pressure (V5) – Increases freelift hoisting pressure. Balances freelift and mainlift hoisting pressure and make pressure available to clamping circuit.



IMPORTANT: Check that V2 is completely turned out (counterclockwise) before adjustment process.

- 1 Install the pressure gauge (Cascade Pressure Test Kit 6034612) in the long arm clamp cylinder gauge port.
- 2 Adjust the Starting Pressure (V1) cartridge so that a light load is not damaged or over clamped and the heaviest load does not slip upon hoisting.

NOTE: For attachments that are retrofitted from three position relief to HFC system and lowest pressure is known, use the lowest pressure as starting pressure.

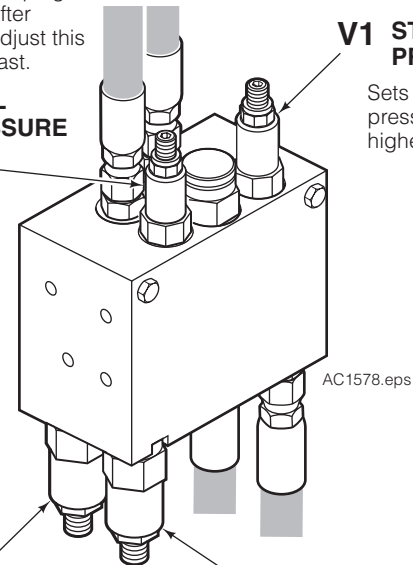
- 3 To prevent carriage/attachment from lowering during arm closing, adjust the Static Hoist Pressure (V3) cartridge. This pressure must be less than the Starting Pressure (V1).
 - If the maximum weight load slips when hoisting, reduce V3 by turning counterclockwise (CCW).
 - If the carriage lowers when closing the arms of the clamp, increase V3 by turning clockwise (CW).
- 4 To limit the maximum clamp pressure (V4), fully close arms without a load and hoist to maximum lift. Fully extend the mast and hold the lever for 2 seconds. Lower the mast without unclamping and check the pressure. If the pressure exceeds the desired maximum clamp pressure for the heaviest load, turn the cartridge (V4) CCW to decrease the maximum pressure.

Adjusts clamping pressure after hoisting. Adjust this cartridge last.

FINAL PRESSURE V2

V1 STARTING PRESSURE

Sets starting pressure. Must be higher than V3.



V3 STATIC HOIST PRESSURE

Closes connection from hoist line to clamp line. Must be lower than V1.

V4 MAXIMUM CLAMP PRESSURE

Limit maximum clamping pressure.

5 To equalize the hoist pressure between freelif and mainlift, clamp an average load and hoist off the ground about 1 ft (30 cm) (freelift). Record the pressure. With the same load at a higher position (mainlift), set load down in mainlift position. Reclamp the load, hoist the load and lower to the ground without unclamping. Record the pressure.

- If pressure is within 150 psi (10.5 bar), no adjustment is required.
- If mainlift pressure is higher than the freelift pressure, increase V5 by turning CW to equalize pressure.
- If freelift pressure is higher than the mainlift pressure, decrease V5 by turning CCW to equalize pressure.

6 For non-freelift mast large trucks with small attachments, clamp pressure may need to be increased. If equipped, the solenoid should be powered at all times by mounting the sensor switch in a location that will always switch on a ferrous object. Clamp a roll and hoist. Note the clamp cylinder pressure.

- If the pressure is less than the desired clamp pressure, increase the pressure by turning V5 in CW to match the desired clamp pressure.

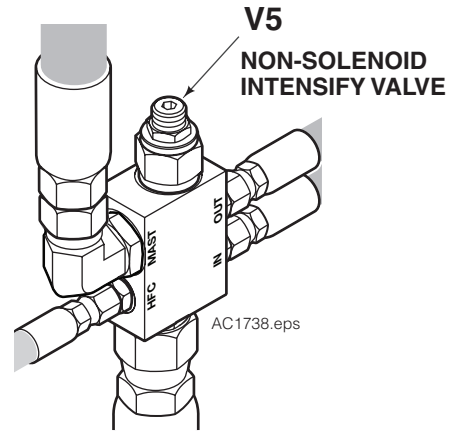
NOTE: For freelift mast large trucks with small attachments and adequate clamp pressure can not be achieved with the standard valve, a special equalizer valve may be required. Contact Cascade for more detail.

7 To adjust the Final Pressure (V2), clamp a load. Hoist the load. Use the chart below to record the initial clamp pressure. If the pressure is too high for the heaviest load, turn the cartridge CW to reduce the adjusted clamp pressure. Record the adjusted clamp pressure.

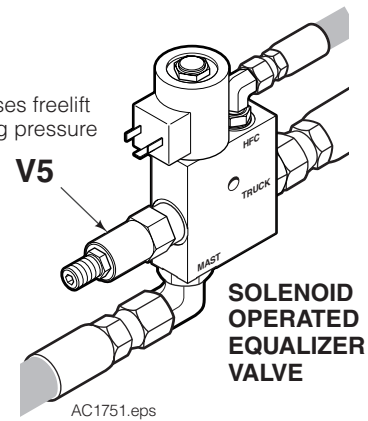
ROLL WEIGHT	INITIAL CLAMP PRESSURE ●	ADJUSTED CLAMP PRESSURE ●
#1		
#2		
#3		
#4		
#5		

● Read from long arm clamp cylinder gauge port

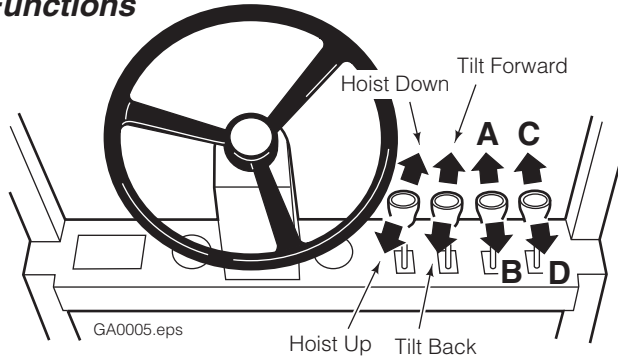
Increases freelift hoisting pressure



Increases freelift hoisting pressure



Auxiliary Valve Functions

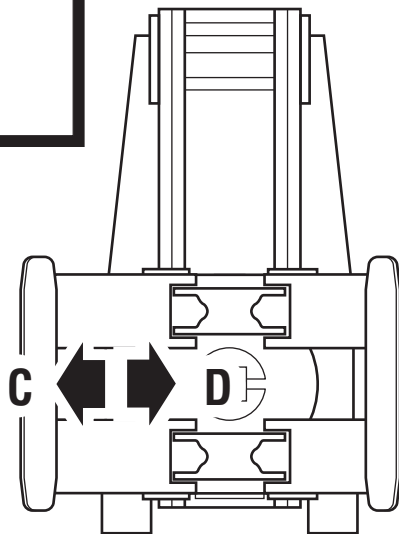


WARNING: Truck control handle and attachment function activation shown here conforms to ASME/ANSI B56.1 recommended practices. Failure to follow these practices may lead to serious bodily injury or property damage. End user, dealer and OEMs should review any deviation from the practices for safe operation.

LONG ARM

(vertical & horizontal positions only)

- C** Release
- D** Clamp



ROTATE

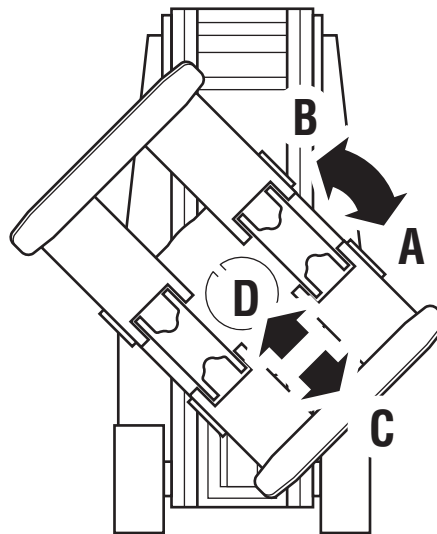
(Driver's view)

- A** Counterclockwise (CCW)
- B** Clockwise (CW)

SHORT ARM

(45-degree position only)

- C** Open
- D** Close



The HFC system works fundamentally the same as a normal lift truck system when used with a paper roll clamp. Use the following techniques when clamping loads:

- 1** Clamp arms firmly on the roll. Hold for 1 second to build starting clamp pressure.
- 2** Lift the load. Clamp pressure will automatically increase according to load weight.
- 3** If feathering is used to reduce clamp force on light loads, use the same process with HFC. However, it is recommended to use the techniques above for all loads unless absolutely necessary.

CAUTION: Develop adequate clamp force to hold the load when feathering.

- 4** Operation for a split arm clamp with HFC is the same as a solid arm clamp except for the following:

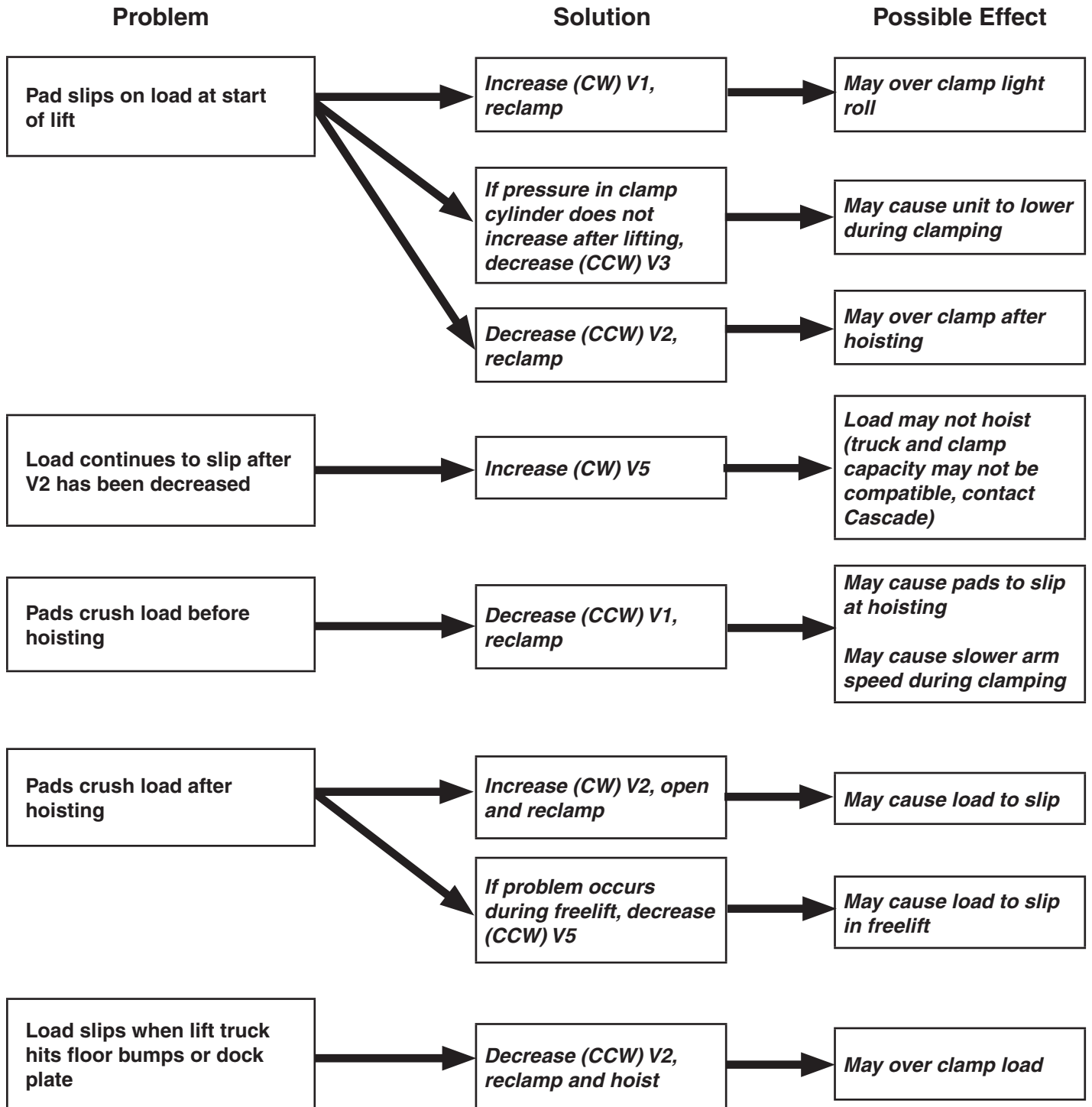
- HFC should be used with the Cascade full arm travel split arm circuit. Close the free arm fully when handling one roll with one split arm. Full clamp force develops after free arm bottoms.
- When clamping a full height roll with both split arms, operate the clamp as a solid arm clamp.

NOTE: HFC allows lower clamp starting pressures so that light loads can be handled without damage along with heavier loads. Slightly slower arm speed is normal. If roll diameters vary widely with very low starting pressures, the slower arm speed can be corrected with an optional arm overdrive system. Consult Cascade.

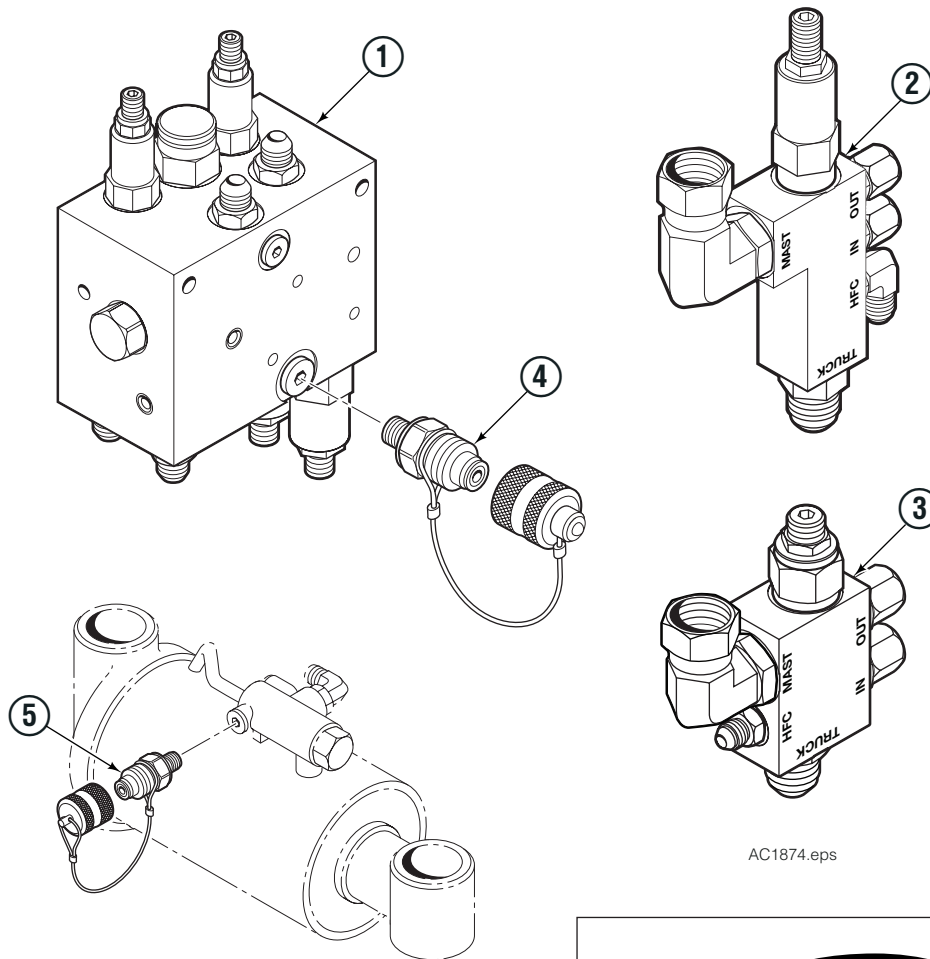
TROUBLESHOOTING

CAUTION: Prior to troubleshooting, verify that clamp is working properly and check for defective check valves and cylinder seals.

NOTE: When adjusting cartridges, turn in 1/2 turn increments.



Problem	Solution	Possible Effect of Solution
Hoist cylinder will not lift with a high capacity load	Decrease (CCW) V5	May cause mainlift and freelif to be unbalanced
Hoist lowers while closing arms	Increase (CW) V3	May not add pressure during hoisting
Hoist speed is decreased	Decrease (CCW) V5	May have more clamp pressure in mainlift than freelif. Available clamping pressure in freelif will be reduced.
Clamped pressure is substantially higher in freelif over mainlift	Install switch if not installed	Improved accuracy
	Decrease (CCW) V5	Load may slip in freelif
Clamped pressure is substantially lower in freelif over mainlift	Increase (CW) V5	May over clamp in freelif
Over clamps when mast runs out of travel	Increase (CW) V4	May cut off needed clamp pressure on heavy loads
Arm speed is too slow during clamping	Increase (CW) V1	May over clamp light loads
	Light loads that require low starting pressure, install optional arm overdrive system	Driver may overclamp load if button is not released in time or relief not properly set.



AC1874.eps



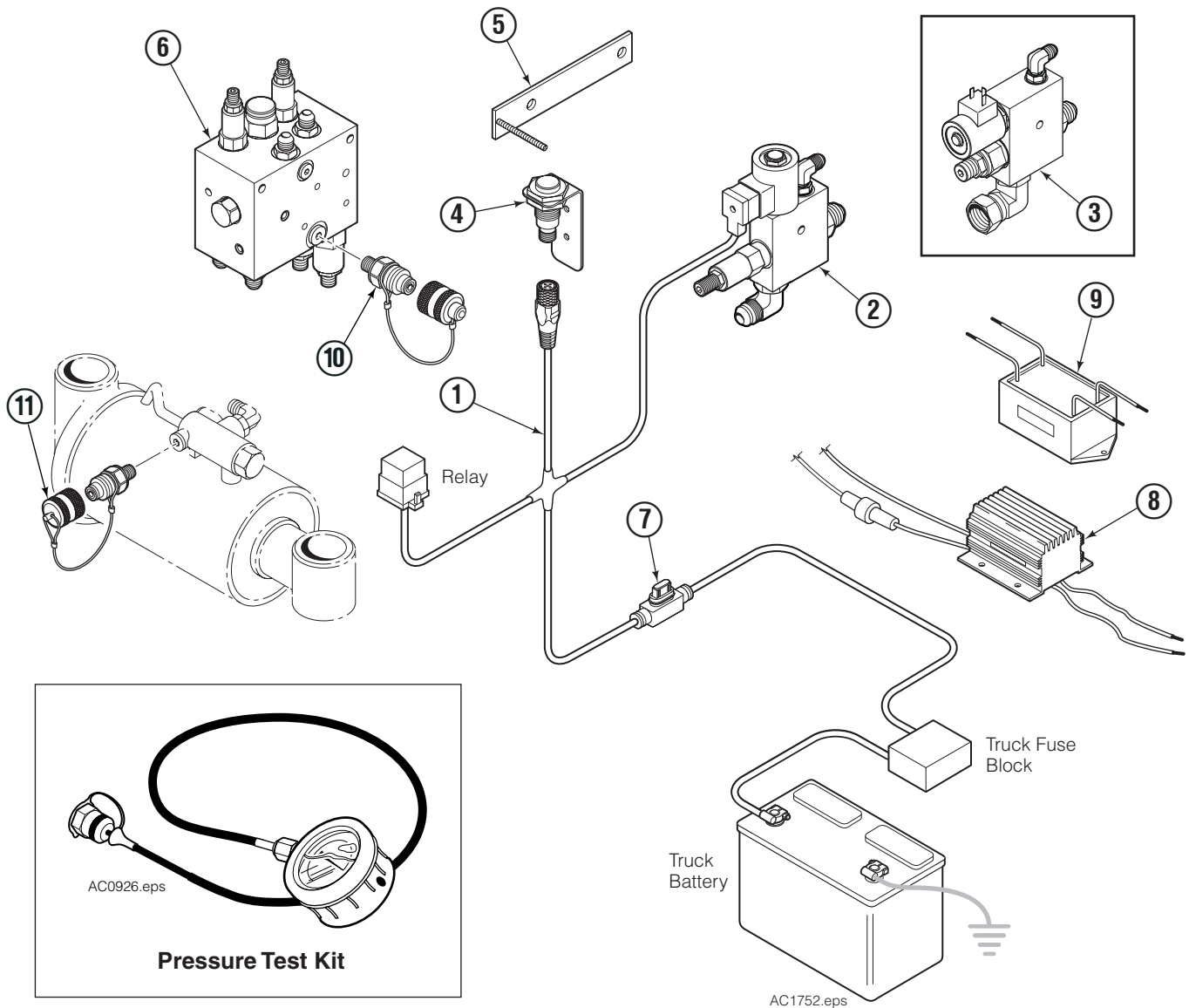
AC0926.eps

Pressure Test Kit

REF	QTY	BASIC FLOW PART NO.	HIGH FLOW PART NO.	DESCRIPTION
		6097593	6093682	HFC Kit – without switch
1	1	6088041	6088041	HFC Valve
2	1	6088536	–	Non-Solenoid Intensify Valve - Basic
3	1	–	6092596	Non-Solenoid Intensify Valve - High
4	1	6006014	6006014	Test Point Fitting, 6-6
5	2	6004478	6004478	Test Point Fitting, 4-4
	1	6034612	6034612	Pressure Test Kit

PARTS

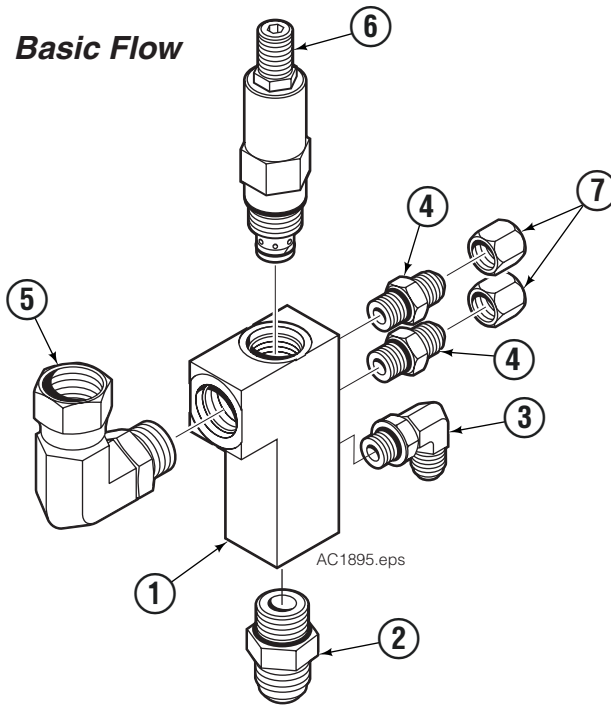
HYDRAULIC FORCE CONTROL KITS – FULL FREELIFT MAST



REF	QTY	BASIC FLOW PART NO.	BASIC FLOW PART NO.	HIGH FLOW PART NO.	HIGH FLOW PART NO.	DESCRIPTION
		6096281		6097470		HFC Kit – 12V
			6096662		6097471	HFC Kit – 24V-48V
			217932		217932	Converter and Filter Kit ■
1	1	6095957 ◆	6095957 ●	6095957 ◆	6095957 ●	Wire Harness
2	1	6096282	6096282	–	–	Solenoid Operated Equalizer Valve - Basic Flow
3	1	–	–	6097081	6097081	Solenoid Operated Equalizer Valve - High Flow
4	1	6095969 ◆	6095969 ●	6095969 ◆	6095969 ●	Switch Assembly
5	1	6095839 ◆	6095839 ●	6095839 ◆	6095839 ●	Switch Mounting Bracket
6	1	6088041	6088041	6088041	6088041	HFC Valve
7	1	6017897 ◆	6017897 ●	6017897 ◆	6017897 ●	Fuse - 5 amp
8	1	–	6061953 ●	–	6061953 ●	Voltage Converter, 24-48V→12V
9	1	–	6064659 ●	–	6064659 ●	Voltage Filter
10	1	6006014	6006014	6006014	6006014	Test Point Fitting, 6-6
11	2	6004478	6004478	6004478	6004478	Test Point Fitting, 4-4
	1	6034612	6034612	6034612	6034612	Pressure Test Kit

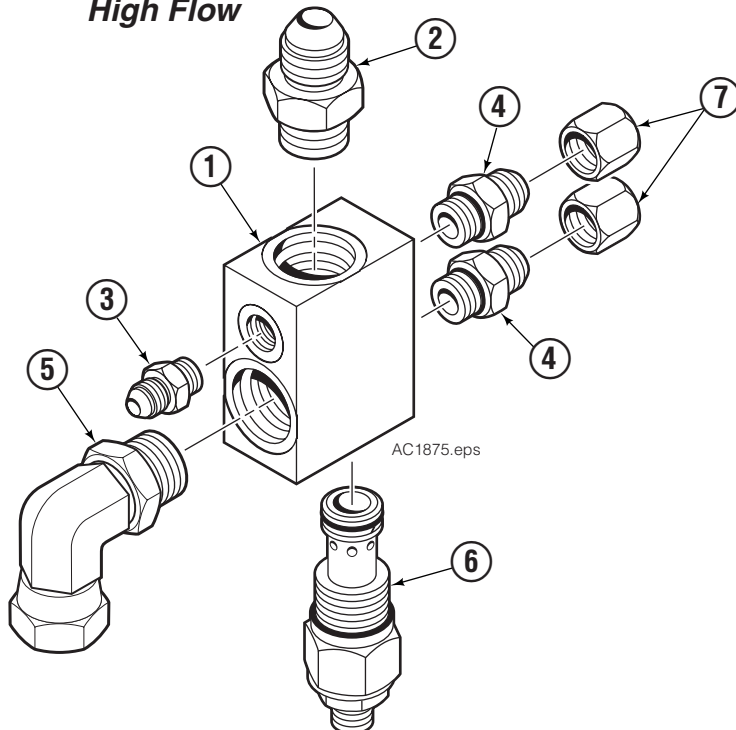
- Includes items 7 & 8.
- ◆ Included in Switch Group 6097464
- Included in Switch Group 6097465

Basic Flow



REF	QTY	PART NO.	DESCRIPTION
		6088536	Non-Solenoid Intensify Valve
1	1	6088413	Valve Body
2	1	611291	Fitting, 10-10
3	1	601676	Fitting, 6-6
4	2	604511	Fitting, 6-6
5	1	6097545	Fitting, 10-10
6	1	6088046	Relief Valve Cartridge
7	2	2645	Plug

High Flow

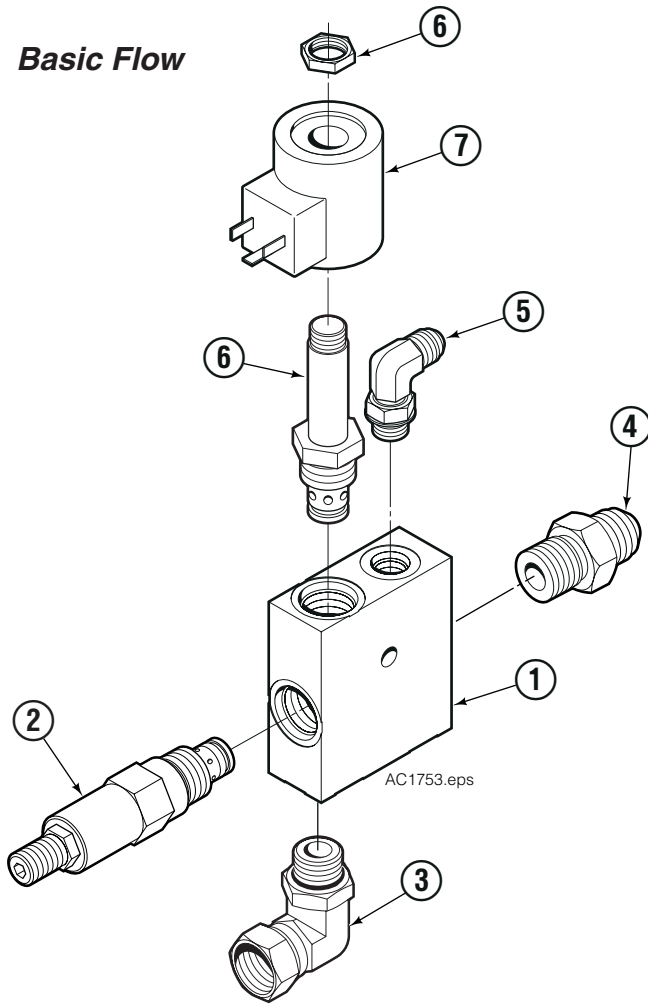


REF	QTY	PART NO.	DESCRIPTION
		6092596	Non-Solenoid Intensify Valve
1	1	6092590	Valve Body
2	1	611293	Fitting, 12-12
3	1	604511	Fitting, 6-6
4	2	601377	Fitting, 8-8
5	1	6093794	Fitting, 12-12
6	1	6092647	Relief Valve Cartridge
7	2	2646	Plug

PARTS

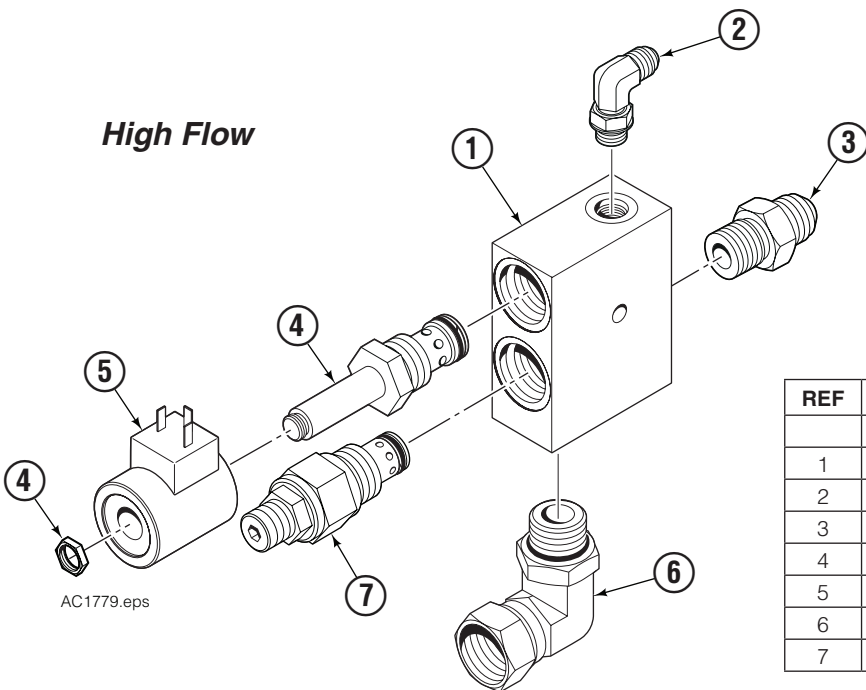
SOLENOID OPERATED EQUALIZER VALVE

Basic Flow

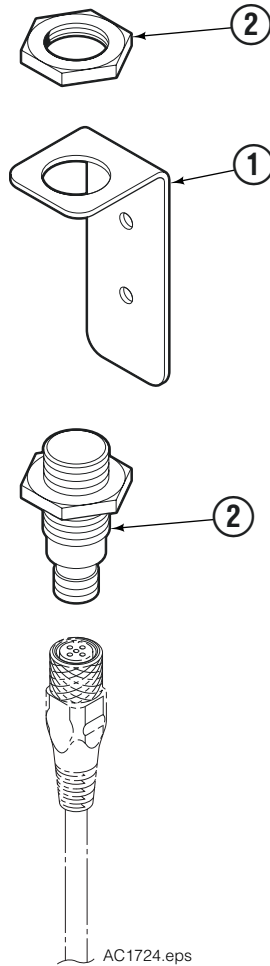


REF	QTY	PART NO.	DESCRIPTION
		6096282	Low Flow Equalizer Valve
1	1	6096291	Valve Body
2	1	6088046	Relief Valve Cartridge
3	1	6097545	Fitting, 10-10
4	1	611291	Fitting, 10-10
5	1	601676	Fitting, 6-6
6	1	221192	Solenoid Valve
7	1	6014287	Coil - 12V

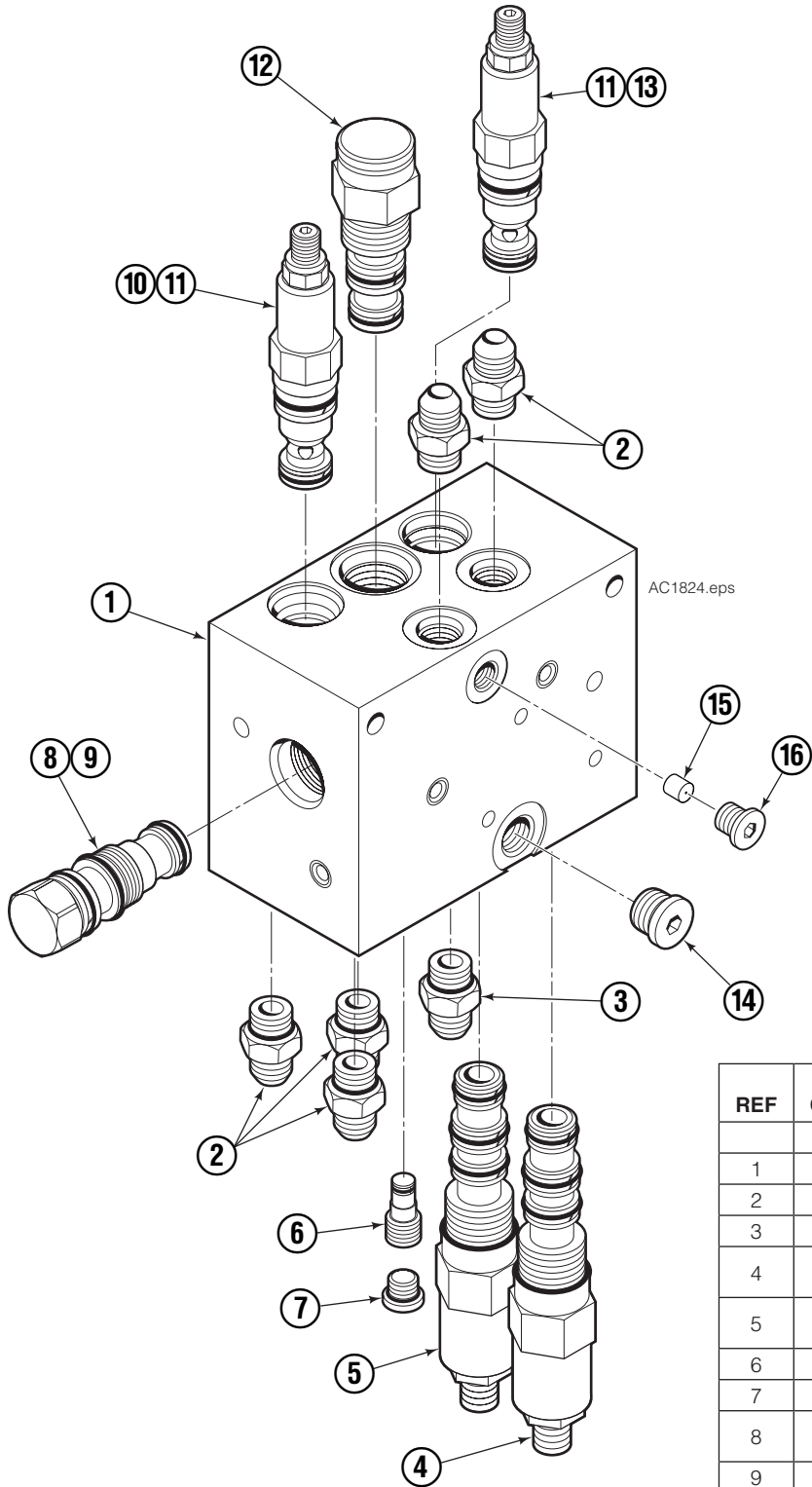
High Flow



REF	QTY	PART NO.	DESCRIPTION
		6097081	High Flow Equalizer Valve
1	1	6097065	Valve Body
2	1	601676	Fitting, 6-6
3	1	611293	Fitting, 12-12
4	1	6056977	Solenoid Valve
5	1	6014287	Coil - 12V
6	1	6093794	Fitting, 12-12
7	1	6092647	Relief Valve Cartridge



REF	QTY	PART NO.	DESCRIPTION
		6095969	Switch Assembly
1	1	6091430	Bracket
2	1	6092966	Switch



REF	QTY	BASIC FLOW PART NO.	HIGH FLOW PART NO.	DESCRIPTION
		6083794	6088041	HFC Valve ■
1	1	6083793	6088042	Valve Body
2	5	604511	601377	Fittings
3	1	604511	604511	Fitting
4	1	6091000	6091000	Pressure Sequence Valve Cartridge
5	1	6090999	6090999	Pressure Sequence Valve Cartridge
6	1	220865	220865	Shuttle Valve
7	2	609234	609234	Plug
8	1	6038929	210379	PO Check Valve Cartridge
9	1	-	6024964	Seal Kit
10	1	661676	661676	Relief Valve Cartridge
11	2	661312	661312	Seal Kit
12	1	6086327	6086327	Directional Valve Cartridge
13	1	6098001	6098001	Relief Valve Cartridge
14	1	604510	604510	Plug
15	1	6054498	6054498	Orifice .020
16	1	663694	663694	Plug

■ Refer to Glossary for flow requirements

Basic Flow – Trucks with a delivered flow volume of 18 GPM (68 L/min.) or less.

Clamp Pressure – Pressure set to clamp a load.

Final Pressure (V2) – The final HFC adjusted clamp pressure applied when the load is hoisted.

Freelift Pressure (V5) – Pressure in the hoist line when the mast is in freelift state.

High Flow – Trucks with a delivered flow volume greater than 18 GPM (68 L/min.).

Mainlift Pressure (V5) – Pressure in the hoist line when the mast has extended above freelift.

Maximum Clamp Pressure (V4) – The maximum pressure set to clamp a load.

Overdrive System – A system to aid with increasing arm speed and allows an attachment to have higher clamping pressure when breaking out rolls.

Starting Pressure (V1) – The minimum clamp pressure that will be applied, even on light loads.

Static Hoist Pressure (V3) – The hoist pressure to achieve prior to hoisting.

Total Load Weight – The sum of the paper roll weight and clamp weight.

Do you have questions you need answered right now? Call your nearest Cascade Service Department. Visit us online at www.cascorp.com

**Cascade Corporation
U.S. Headquarters**
2201 NE 201st
Fairview, OR 97024-9718
Tel: 800-CASCADE (227-2233)
FAX: 888-329-8207

Cascade Canada Inc.
5570 Timberlea Blvd.
Mississauga, Ontario
Canada L4W-4M6
Tel: 905-629-7777
FAX: 905-629-7785

Cascade GmbH
Niederwippékühl 1
58579 Schalksmühle
Germany
Tel: 02355-50900
FAX: 02355-509020

Cascade Finland
A. Petreliuksenkatu 3
01370 Vantaa
Finland
Tel: 09-8361925
FAX: 09-8361935

**Cascade N.V.
Benelux Sales and Service**
Damsluisweg 56
PO Box 3009
1300 El Almere
The Netherlands
Tel: 036-5492950
FAX: 036-5492974

Cascade Kenhar Ltd.
3 Kelbrook Road
Parkhouse Ind. Estate
Openshaw,
Manchester M11 2DD
England
Tel: 0800-243015
FAX: 0161-4384055

**Sales Scotland
Macade Systems Ltd.**
18 Melford Road
Righead Ind. Estate
Bellshill ML4 3LR
Scotland
Tel: 01698-845777
FAX: 01698-845888

Cascade (Africa) Pty. Ltd.
PO Box 625, Isando 1600
60A Steel Road
Sparton, Kempton Park
South Africa
Tel: 27-11-975-9240
FAX: 27-11-394-1147

Cascade Scandinavia AB
Hammarvägen 10
PO Box 124
S-56723 Vaggeryd
Sweden
Tel: 039-336950
FAX: 039-336959

**Cascade France
S.A.R.L. MHP**
1D Rue De Charaintru BP 18,
91360 Epinay-Sur-Orge
France
Tel: 01-6454-7500
FAX: 01-6454-7501

Cascade Hispania S.A.
Carrer 5, Sector C
Zona Franca Duanera
Poligono de la Zona Franca
08040 Barcelona, Spain
Tel: 93-264-07-30
FAX: 93-264-07-31

Cascade Italia S.R.L.
Via Dell'Artigianato 1
37050 Vago di Lavagno (VR)
Italy
Tel: 39-045-8989111
FAX: 39-045-8989160

Movimenta Lda.
Parque Industrial
Vale do Alecrim, Lote 108
2950-403 Palmela
Portugal
Tel: 351-212387340
FAX: 351-212387349

**Sales Switzerland
Fahrzeugbedarf**
8810, Horgen
Switzerland
Tel: 01-7279797
FAX: 01-7279798

Sales Poland
Targowa 35/61
03-728 Warszawa
Tel: 022-619 00 49
FAX: 022-619 00 49
Mobile Tel: 0501-27 29 55

Sales Russia
EMCG Material Handling
Equipment
Moscow
Tel: 095-795-2400
FAX: 095-795-2475
Email: emcg@emcg.ru

Cascade Japan Ltd.
5-5-41,
Torikai Kami
Settsu, Osaka
Japan, 566
Tel: 81-726-53-3490
FAX: 81-726-53-3497

Cascade Korea
121B 9L Namdong Ind.
Complex, 691-8 Gojan-Dong
Namdong-Ku
Inchon, 405-310 Korea
Tel: 82-32-821-2051
FAX: 82-32-821-2055

Cascade Australia
1445 Ipswich Road
Rocklea, QLD 4107
Australia
Tel: 1-800-227-223
FAX: 617-3373-7333

Cascade New Zealand
15 Ra Ora Drive
East Tamaki, Auckland
New Zealand
Tel: 64-9-273-9136
FAX: 64-9-273-9137

Cascade-Xiamen
No. 668 Yangguang Rd.
Xinyang Industrial Zone
Haicang, Xiamen City
Fujian Province
P.R. China 361026
Tel: 86-592-651-2500
FAX: 86-592-651-2571

**Sunstream Industries
Pte Ltd.**
No. 3 Tuas Link 1
2263
Singapore
Tel: 65-6863-3488
FAX: 65-6863-1368

**Cascade do Brasil
LTDA**
Rua João Guerra, 134
Macuco, Santos - SP
Brasil 11015-130
Tel: 55-13-2105-8800
Fax: 55-13-2105-8899

