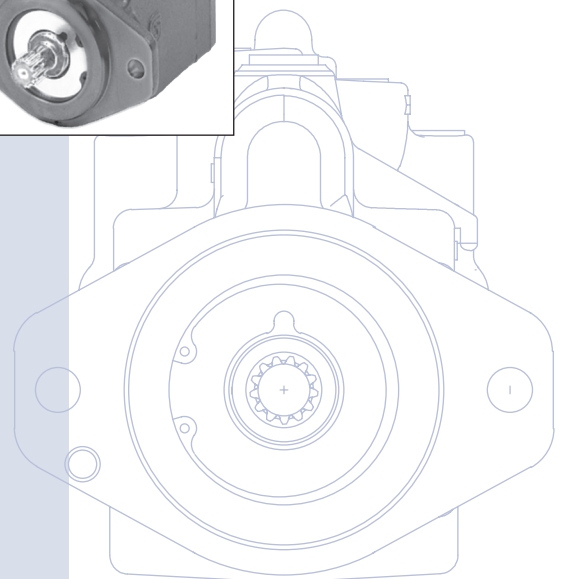
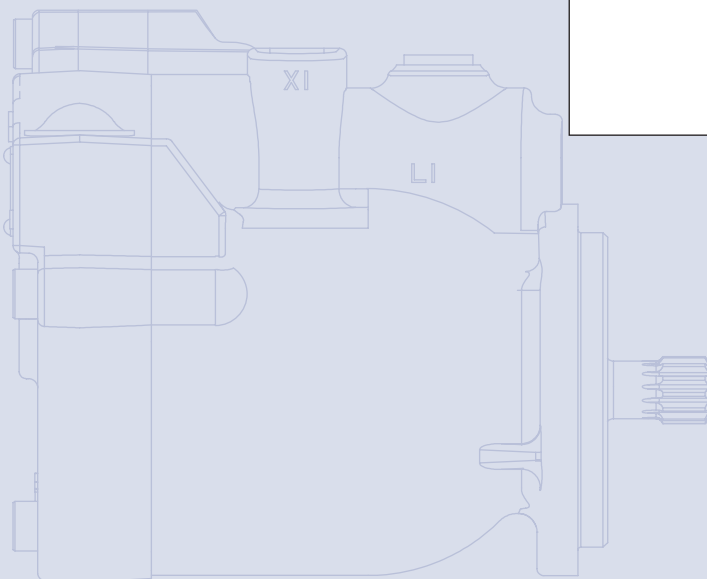
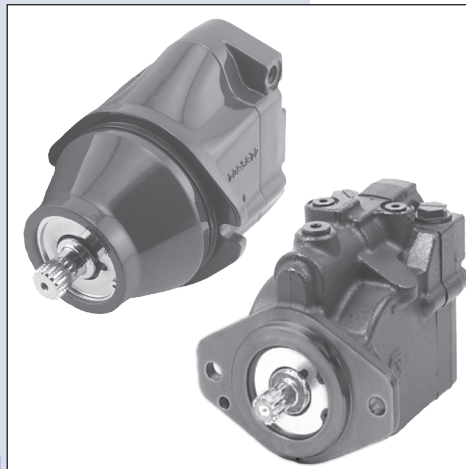
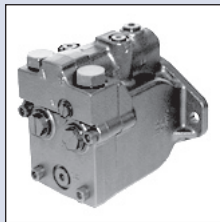
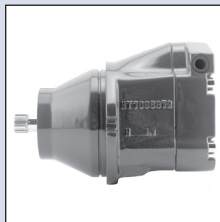




L and K Frame Variable Motors

Technical Information



REVISIONS

Table of Revisions

| Date | Page | Changed | Rev. |
|----------------|---------|--|------|
| September 2009 | 7, 16 | L35 Max. pressure 300 bar [4350 psi], and speed ring pulses L = 41, K = 44 | BF |
| April 2008 | 6 | corrected the schematic drawings | BE |
| January 2008 | 17 | removed displacement limiter setting F12 - 65.3% | BD |
| April 2007 | 18 | LV (41 pulses/rev) KV (44 pulses/rev) | BC |
| March 2007 | 18 | changed 41 pulses/rev to 44 pulses/rev | BB |
| October 2006 | Various | Added Loop flushing valve and 5 bolt endcap | B |
| February 2004 | - | First edition | A |

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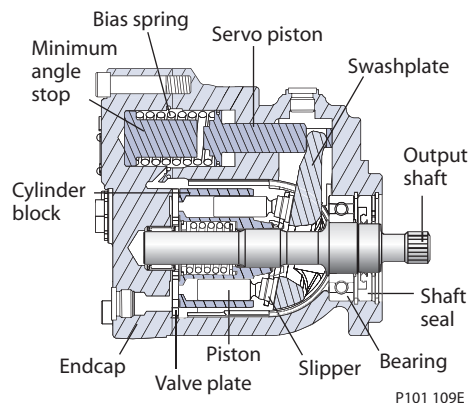
BASIC DESIGN

The L and K Frame variable motors are light to medium power two-position axial piston motors incorporating an integral servo piston. They are designed for operation in closed circuit applications. The L and K Frame motors consist of five unique rotating groups (displacements) and two housing (mounting) configurations. An SAE-B, two-bolt, and a cartridge style (for space-optimized gearbox mounting) configurations are available for each frame. Maximum speeds and maximum applied pressures for each displacement vary. The standard control is a direct acting single line hydraulic control. For SAE-B mount motors a two line control is also available. The integral servo piston controls motor displacement.

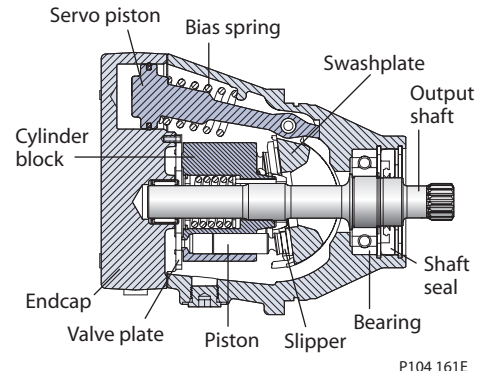
The motor is spring biased to maximum displacement and hydraulically shifted to minimum displacement. Minimum and maximum displacement can be set with fixed internal stops. The large diameter servo piston allows smooth acceleration and deceleration with relatively large circuit orificing.

The motor is ideally configured for installations requiring compact packaging and optimized plumbing, such as wheel ends. One face of the motor contains all hydraulic porting. Two standard porting configurations are available: twin radial (side) or axial (end) O-ring boss main ports.

Cross section, SAE-B mount



Cross section, cartridge mount

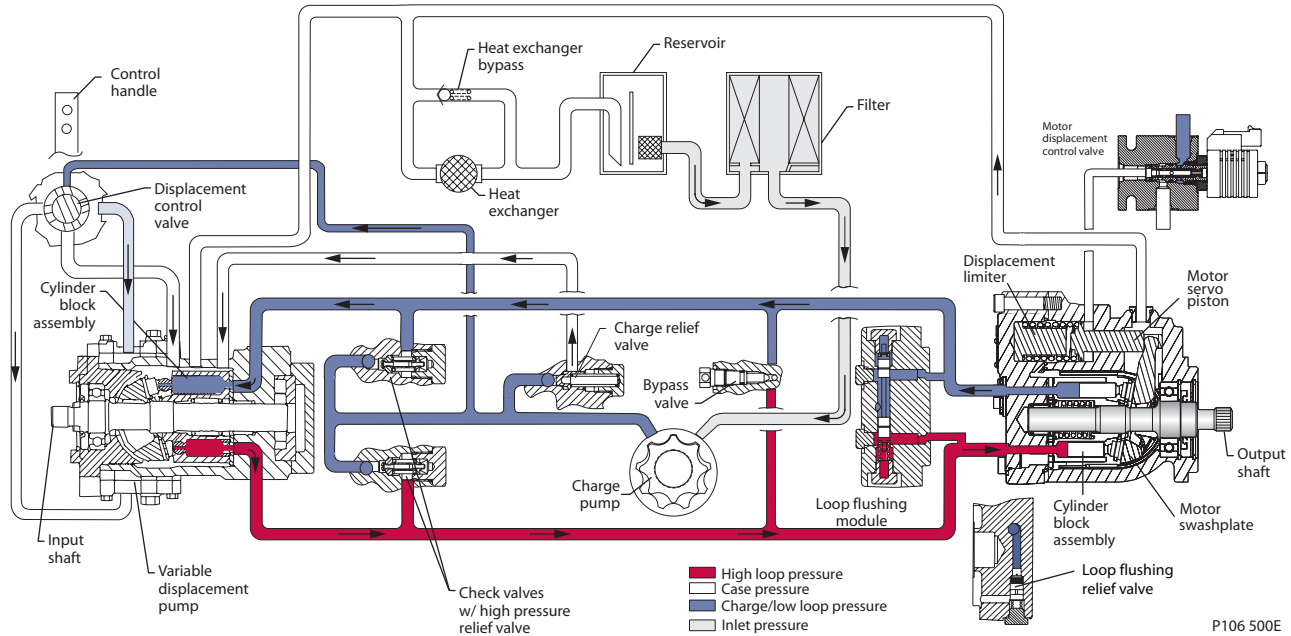


KEY FEATURES

- Five displacements allow the optimum selection of hydraulic motor for the lowest possible installed cost.
- SAE-B, two-bolt, and cartridge mounting configurations available.
- Short and compact; fits into existing installation with improved porting.
- Three clean sides with superior clearance and access to mounting bolts.
- High Efficiency - nine piston rotating groups with 18 degree maximum angle.
- Versatility - working displacement range of 3.4:1 with a minimum angle option to one degree overcenter (-1°).
- Reliability - uses existing and proven technology.
- Worldwide service and technical support.

**SYSTEM CIRCUIT
DIAGRAM**

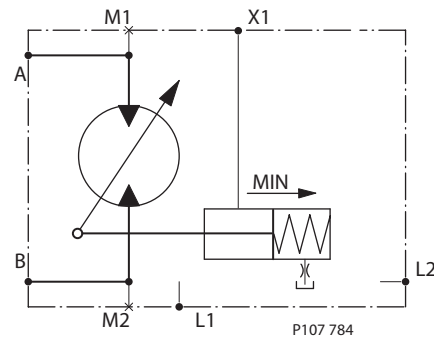
Pictorial system diagram



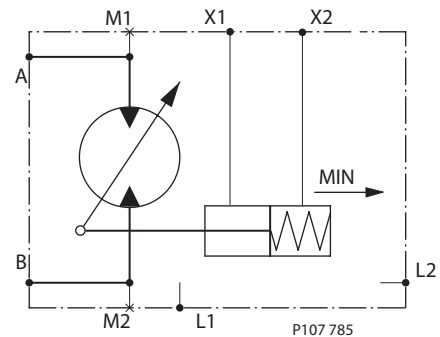
The circuit above shows the LV/KV motor in a simple closed-loop hydrostatic propel application. The motor is driven by a Series 40 M46 axial piston pump with manual displacement control. The motor shown uses a single line hydraulic displacement control. Control pressure applied through an external control valve shifts the motor to minimum displacement, spring force returns the motor to maximum displacement in the absence of control input.

**MOTOR SCHEMATIC
DIAGRAMS**

Motor schematic, single line control



Motor schematic, dual line control



OVERVIEW

Specifications and operating parameters for L and K Frame motors are given here for quick reference. For additional information, see *Operating parameters*, page 10, *Features and options*, page 19 and *Product coding*, page 16.

FEATURES AND OPTIONS

| Mount | SAE-B (LV/KV) | Cartridge (LC/KC) |
|-----------------------|---|------------------------------------|
| Motor type | Inline, axial piston, positive displacement, two-speed variable motors | |
| Displacement | L: 25, 30, or 35 cm ³ [1.50, 1.83, or 2.14 in ³] K: 38 or 45 cm ³ [2.32 or 2.75 in ³] | |
| Rotation | Bidirectional | |
| Installation position | Discretionary: Housing must always be filled with hydraulic fluid | |
| Porting | SAE O-ring boss, axial or twin radial | SAE O-ring boss, twin radial |
| Output shafts | Splined 13 or 15 tooth 16/32 pitch, 0.875 in. straight keyed, and 1:8 taper | Splined 13 or 15 tooth 16/32 pitch |
| Control options | Single or dual line hydraulic control | Single line hydraulic control |
| Displacement limiter | Fixed maximum and minimum displacement limiters available | |
| Speed sensor | Available - refer to Features and options section | |
| Loop Flushing Valve | Available - refer to Features and options section | |

SPECIFICATIONS

| Parameter | Unit | L25 | L30 | L35 | K38 | K45 |
|---|---|---------------------|---------------------|---------------------|---------------------|---------------------|
| Displacement (maximum) | cm ³ [in ³] | 25 [1.50] | 30 [1.83] | 35 [2.14] | 38 [2.32] | 45 [2.75] |
| Weight (cartridge and SAE-B) | kg [lb] | 15.4 [34] | | | | |
| Mass moment of inertia of rotating components | kg•m ² [slug•ft ²] | 0.001666 [0.001229] | 0.001582 [0.001167] | 0.001530 [0.001128] | 0.002326 [0.001716] | 0.002286 [0.001687] |
| Theoretical torque | N•m/bar [lbf•in/1000psi] | 0.40 [244] | 0.48 [293] | 0.56 [347] | 0.60 [366] | 0.72 [439] |

OPERATING PARAMETERS

| Parameter | | Unit | L25 | L30 | L35 | K38 | K45 |
|---|------------|-------------------------|---------------|---------------|---------------|---------------|---------------|
| System pressure | continuous | bar [psi] | 210 [3045] | 175 [2540] | 140 [2030] | 210 [3045] | 175 [2540] |
| | maximum | | 415 [6020] | 350 [5075] | 300 [4350] | 415 [6020] | 350 [5075] |
| Speed limit (at max. disp) | continuous | min ⁻¹ (rpm) | 3400 | 3500 | 3600 | 3600 | 3500 |
| | maximum | | 3950 | 4150 | 4300 | 4000 | 3900 |
| Speed limit (at min. disp) | continuous | | 4400 | 4450 | 4500 | 4650 | 4500 |
| | maximum | | 5000 | 5150 | 5300 | 5200 | 5050 |
| Case pressure | continuous | bar [psi] | 2 [29] | | | | |
| | maximum | | 6 [87] | | | | |
| Shift pressure (single line control) | minimum | bar [psi] | 14 [203] | | | | |
| | maximum | | 69 [1000] | | | | |

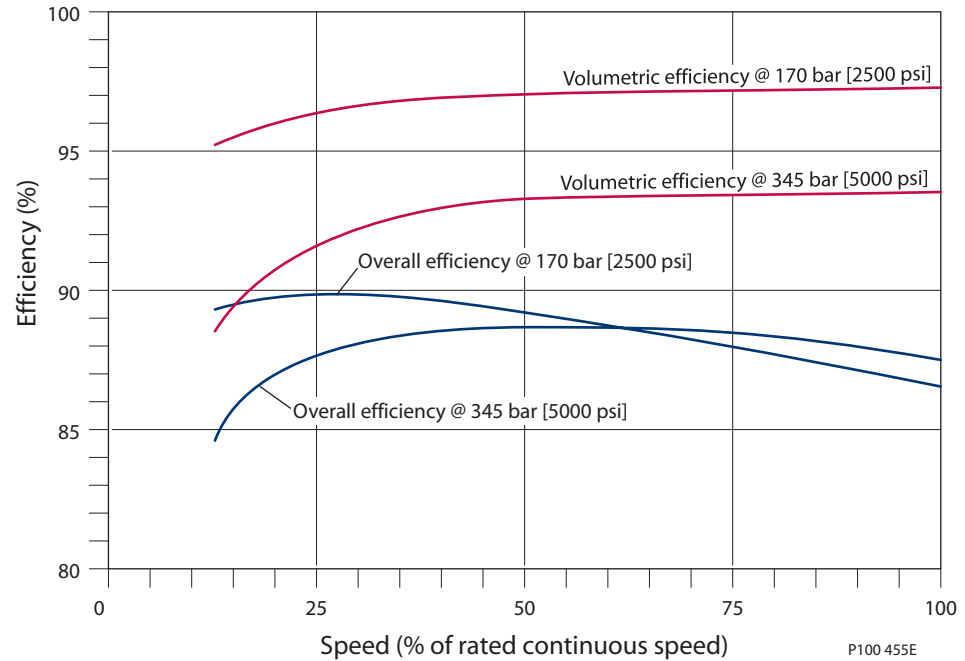
FLUID SPECIFICATIONS

Ratings and data are based on operation with premium petroleum-based hydraulic fluids containing oxidation, rust, and foam inhibitors.

| Parameter | Unit | Minimum | Continuous | Maximum |
|-----------------------|----------------------------------|--|----------------|-------------|
| Viscosity | mm ² /sec (cSt) [SUS] | 7 [47] | 12-60 [70-278] | 1600 [7500] |
| Temperature | °C [°F] | -40 [-40] | 82 [180] | 104 [220] |
| Cleanliness | | ISO 4406 Class 18/13 or better | | |
| Filtration efficiency | suction filtration | $\beta_{35-44}=75$ ($\beta_{10} \geq 1.5$) | | |
| | charge filtration | $\beta_{15-20}=75$ ($\beta_{10} \geq 10$) | | |

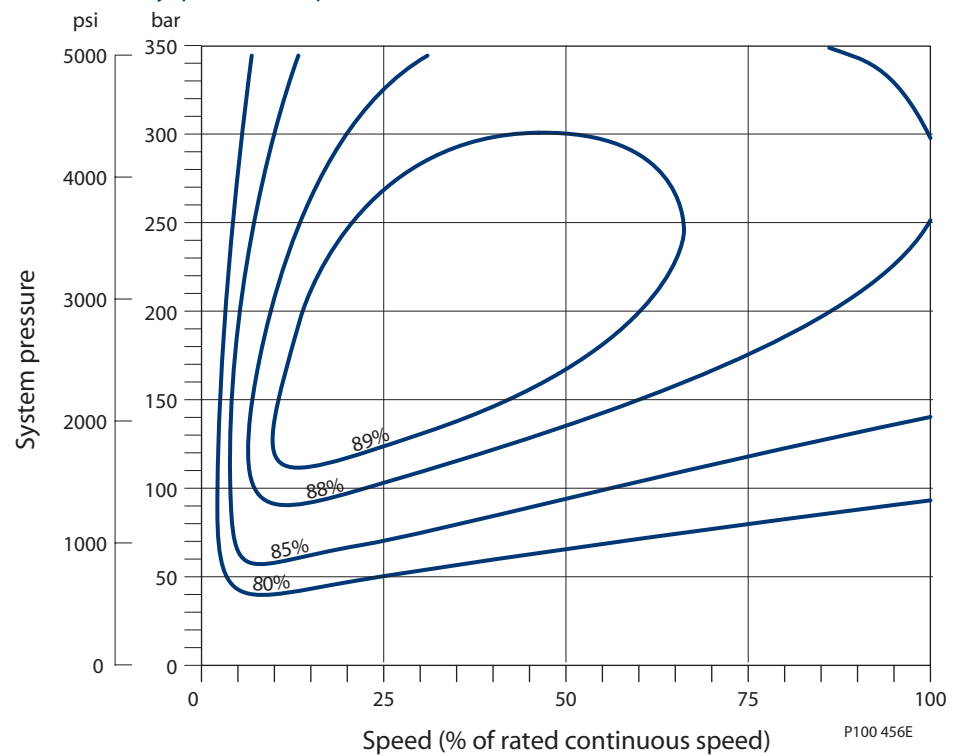
PERFORMANCE

Volumetric and overall efficiency vs. speed



Typical performance at max. displacement

Overall efficiency (pressure vs. speed)



Typical performance at max. displacement

FLUIDS

Ratings and performance data for L and K Frame motors are based on operating with premium hydraulic fluids containing oxidation, rust, and foam inhibitors. These include premium turbine oils, API CD engine oils per SAE J183, M2C33F or G automatic transmission fluids (ATF), Dexron II (ATF) meeting Allison C-3 or Caterpillar T0-2 requirements, and certain specialty agricultural tractor fluids. For more information on hydraulic fluid selection, see Sauer-Danfoss publications: **520L0463**, *Hydraulic Fluids and Lubricants, Technical Information*, and **520L465**, *Experience with Biodegradable Hydraulic Fluids, Technical Information*.

VISCOSITY

Maintain fluid viscosity within the recommended range for maximum efficiency and bearing life. **Minimum viscosity** should only occur during brief occasions of maximum ambient temperature and severe duty cycle operation. **Maximum viscosity** should only occur at cold start. Limit speeds until the system warms up.

Fluid viscosity limits

| Condition | mm ² /s (cSt) | SUS |
|------------|--------------------------|--------|
| Minimum | 7 | 47 |
| Continuous | 12-60 | 70-278 |
| Maximum | 1600 | 7500 |

TEMPERATURE

Maintain fluid temperature within the limits shown in the table. **Minimum temperature** relates to the physical properties of the component materials. Cold oil will not affect the durability of the motor components. However, it may affect the ability of the motor to transmit power. **Maximum temperature** is based on material properties. Don't exceed it. Measure maximum temperature at the hottest point in the system. This is usually the case drain.

Temperature limits

| | |
|---|-------------------|
| Minimum (intermittent, cold start) | - 40° C [- 40° F] |
| Continuous | 85° C [185° F] |
| Maximum | 105° C [221° F] |

Ensure fluid temperature and viscosity limits are concurrently satisfied.

CHARGE PRESSURE

L and K Frame motors can be operated in closed and open circuit applications. The motors require a charge (positive pressure) in the low side of the system loop for proper lubrication and rotating group operation. Maintain low loop (charge) pressure at a minimum of 3 bar [44 psi] above case pressure.

CASE PRESSURE

Maintain case pressure within the limits shown in the table. The housing must always be filled with hydraulic fluid.

Case pressure limits

| | |
|----------------------------------|----------------|
| Maximum (continuous) | 2 bar [29 psi] |
| Intermittent (cold start) | 6 bar [87 psi] |

⚠ Caution

Operating outside of charge and case pressure limits will damage the motor. To minimize this risk, use full size inlet and case drain plumbing, and limit line lengths.

SHIFT PRESSURE

Minimum shift pressure required to keep motor swashplate at minimum angle is 14 bar [203 psi].

PRESSURE RATINGS

The table, *Specifications*, page 8, gives maximum and continuous pressure ratings for each displacement. Not all displacements operate under the same pressure limits. Definitions of the operating pressure limits appear below.

System pressure is the differential pressure between system ports A and B. It is the dominant operating variable affecting hydraulic unit life. High system pressure, which results from high load, reduces expected life. System pressure must remain at or below continuous working pressure during normal operation to achieve expected life.

Continuous working pressure is the average, regularly occurring operating pressure. Operating at or below this pressure should yield satisfactory product life.

Maximum (peak) working pressure is the highest intermittent pressure allowed. Maximum machine load should never exceed this pressure. For all applications, the load should move below this pressure.

All pressure limits are differential pressures referenced to low loop (charge) pressure. Subtract low loop pressure from gauge readings to compute the differential.

SPEED RATINGS

The table, *Specifications*, page 8, gives rated and maximum speeds for each displacement. Not all displacements operate under the same speed limits. Definitions of these speed limits appear below.

Continuous speed is the maximum recommended operating speed at full power condition. Operating at or below this speed should yield satisfactory product life. In vehicle propel applications, maximum motor speed during unloaded, on-road travel over level ground should not exceed this limit.

Maximum speed is the highest operating speed permitted. Exceeding maximum speed reduces motor life and can cause loss of hydrostatic power and braking capacity. Never exceed the maximum speed limit under any operating conditions.

Warning

Unintended vehicle or machine movement hazard.

The loss of hydrostatic drive line power, in any mode of operation (forward, neutral, or reverse) may cause the system to lose hydrostatic braking capacity. You must provide a braking system, redundant to the hydrostatic transmission, sufficient to stop and hold the vehicle or machine in the event of hydrostatic drive power loss.

INSTALLATION

L and K Frame motors may be installed in any position. The motor housing must always remain full of hydraulic fluid.

Fill the motor housing and system lines with clean fluid during installation. Connect the case drain line to the uppermost drain port (L1 or L2) to keep the housing full during operation.

To allow unrestricted flow to the reservoir, use a dedicated drain line. Connect it below the minimum reservoir fluid level and as far away from the reservoir outlet as possible. Use plumbing adequate to maintain case pressure within prescribed limits (see [Case pressure limits](#), page 10).

FILTRATION

To prevent damage to the motor, including premature wear, fluid entering the motor must be free of contaminants. L and K Frame motors require system filtration capable of maintaining fluid cleanliness at ISO 4406-1999 class 22/18/13 or better.

Consider these factors when selecting a system filter:

- Cleanliness specifications
- Contaminant ingress rates
- Flow capacity
- Desired maintenance interval

Typically, a filter with a beta ratio of $\beta_{10} = 1.5$ to 2.0 is adequate. However, open circuit systems supplied from a common reservoir may have considerably higher requirements. Because each system is unique, only a thorough testing and evaluation program can fully validate the filtration system. For more information, see Sauer-Danfoss publication **520L0467**, *Design Guidelines for Hydraulic Fluid Cleanliness*.

RESERVOIR

The reservoir provides clean fluid, dissipates heat, and removes entrained air from the hydraulic fluid. It allows for fluid volume changes associated with fluid expansion and cylinder differential volumes. Minimum reservoir capacity depends on the volume needed to perform these functions. Typically, a capacity of one half the charge pump flow (per minute) is satisfactory for a closed reservoir. Open circuit systems sharing a common reservoir will require greater fluid capacity.

Locate the reservoir outlet (suction line) near the bottom, allowing clearance for settling foreign particles. Place the reservoir inlet (return lines) below the lowest expected fluid level, as far away from the outlet as possible.

OVERPRESSURE PROTECTION

L and K Frame motors have no internal overpressure protection. Therefore, relief valves or pressure limiters are required to maintain system pressure within prescribed limits. Relief valves are adequate to protect against transient or unusually rapid load application, but excessive or continuous flow through them adds heat to the system and can damage the fluid. In applications operating at or near pressure, use a pressure compensating variable pump.

LOOP FLUSHING

Closed circuit systems may require loop flushing to meet temperature and cleanliness requirements. A loop flushing valve removes hot fluid from the low pressure side of the system loop for additional cooling and filtering. Ensure the charge pump provides adequate flow for loop flushing and the loop flushing valve does not cause charge pressure to drop below recommended limits.

CHARGE FLOW

Closed circuit applications require a charge pump to make up for lubrication and cooling losses, and to charge the low pressure side of the system loop. The total charge flow required is a sum of the charge flow requirements for the pump, plus the flow requirements for all motors in the system, plus any external loop flushing requirements.

CHARGE PRESSURE

For proper operation, L and K Frame motors require a minimum pressure in the low side of the system loop. This **charge pressure** keeps the piston slippers seated against the swashplate and ensures proper lubrication of the motor components. Insufficient charge pressure limits motor speed. For operation at continuous speed, the minimum charge pressure is 3 bar [44 psi] above case pressure.

REDUNDANT BRAKING SYSTEM REQUIREMENT

Warning

Unintended vehicle or machine movement hazard.

The loss of hydrostatic drive line power, in any mode of operation (forward, neutral, or reverse) may cause the system to lose hydrostatic braking capacity. You must provide a braking system, redundant to the hydrostatic transmission, sufficient to stop and hold the vehicle or machine in the event of hydrostatic drive power loss.

SERIES OPERATION

L and K Frame motors may be operated in series configuration as long as system, charge, and case pressure limits are satisfied. Operating motors in series significantly impacts bearing life. Contact your Sauer-Danfoss representative for assistance when applying L and K Frame motors in series configuration.

SHAFT LOADS

L and K Frame motors have bearings capable of accepting some external radial and thrust loads. The external radial shaft load limits are a function of the load position, orientation, and the operating conditions of the motor.

Shaft external load limits

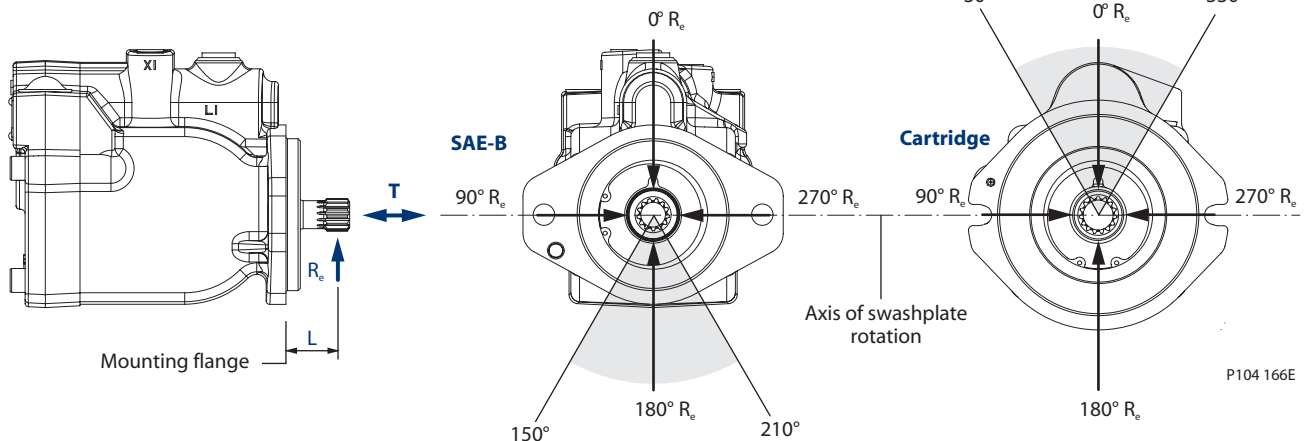
| Frame | | L | | K | |
|---|--------|-----|-----------|------|-----------|
| Mounting configuration | | SAE | Cartridge | SAE | Cartridge |
| Maximum allowable external moment (M_e) | N•M | 7.7 | 21.7 | 13.3 | 37.5 |
| | lbf•in | 68 | 192 | 118 | 332 |
| Maximum allowable thrust load (T) | N | 750 | | 1100 | |
| | lbf | 169 | | 247 | |

The table above gives the maximum allowable external moment (M_e) for a 25% bearing life reduction, with optimum load orientation, operating at maximum continuous pressure (see *Specifications*, page 8). You can compute the allowable radial load (R_e) from the moment (M_e), and the load distance (L) from the mounting flange, using the formula below. The thrust load (T) is the maximum allowable without bearing life reduction, based on the radial load for 25% life reduction and maximum continuous pressure. Maximum allowable thrust load (T) is a function of external radial load and operating pressure, and may or may not impact bearing life. If thrust or radial loads exist that are not a function of the operating load of the motor, or exceed these limits, contact your Sauer-Danfoss representative for application assistance.

Radial load formula

$$M_e = R_e \cdot L$$

Shaft load orientation



DUTY CYCLE AND BEARING LIFE

All shaft loads affect bearing life. In applications where external shaft loads exist, maximize bearing life by orientating the load in the optimal position, as shown in the shaded area above. We recommend tapered shafts or clamp-type couplings for applications with radial shaft loads.

Knowing the operating conditions of your application is the best way to ensure proper motor selection. With accurate duty cycle information, your Sauer-Danfoss representative can assist in calculating expected motor life.

HYDRAULIC EQUATIONS HELPFUL FOR MOTOR SELECTION

Use the following equations to compute output power, torque, speed, and input flow. Selecting the right motor starts with an evaluation of system requirements such as speed and torque. Select a motor that will transmit the required torque, then select a pump that will meet the flow and pressure requirements of the motor. For more information on hydrostatic drive selection, refer to Sauer-Danfoss applications guideline **BLN-9885**, *Selection of Drive Line Components*.

Based on SI units

$$\text{Input flow } Q = \frac{V_g \cdot n}{1000 \cdot \eta_v} \quad (\text{l/min})$$

$$\text{Motor speed } n = \frac{Q \cdot 1000 \cdot \eta_v}{V_g} \quad \text{min}^{-1}(\text{rpm})$$

$$\text{Output torque } M = \frac{V_g \cdot \Delta p \cdot \eta_m}{20 \cdot \pi} \quad (\text{N}\cdot\text{m})$$

$$\text{Output power } P = \frac{Q \cdot \Delta p \cdot \eta_t}{600} \quad (\text{kW})$$

Based on US units

$$\text{Input flow } Q = \frac{V_g \cdot n}{231 \cdot \eta_v} \quad (\text{US gal/min})$$

$$\text{Motor speed } n = \frac{Q \cdot 231 \cdot \eta_v}{V_g} \quad \text{min}^{-1}(\text{rpm})$$

$$\text{Output torque } M = \frac{V_g \cdot \Delta p \cdot \eta_m}{2 \cdot \pi} \quad (\text{lbf}\cdot\text{in})$$

$$\text{Output power } P = \frac{Q \cdot \Delta p \cdot \eta_t}{1714} \quad (\text{hp})$$

Where:

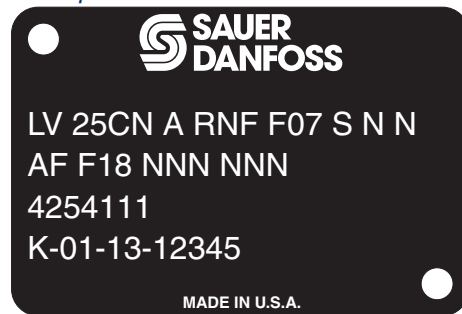
SI units [US units]

| | | |
|------------|--|---|
| V_g | = Displacement per revolution | cm^3/rev [in^3/rev] |
| p_o | = Outlet pressure | bar [psi] |
| p_i | = Inlet pressure | bar [psi] |
| Δp | = $p_o - p_i$ (system pressure) | bar [psi] |
| n | = Speed | min^{-1} (rpm) |
| η_v | = Volumetric efficiency | |
| η_m | = Mechanical efficiency | |
| η_t | = Overall efficiency ($\eta_v \cdot \eta_m$) | |

NAME PLATE

L and K Frame motors are identified by a name plate affixed to the motor housing. The nameplate contains the model number, model code, serial number, and country of manufacture.

Name plate



Model number

A Sauer-Danfoss model number is issued for every unique configuration. Use this number when placing orders.

Model code

The model code completely defines the options for a specific unit. See *Model code*, next page, for available options and codes.

Serial number

Every unit is identified by a unique serial number. The serial number gives manufacturing location, year and week built, and a unique sequence number. The serial number in the example to the left is decoded as:

| | |
|--------------|-----------------------|
| K | Lawrence, Kansas, USA |
| 01 | Year 2001 |
| 13 | Week 13 |
| 67890 | Sequence number |

MODEL CODE

| A B | | C1 2 | | D | E1 2 3 | | | F | G | H | J | K1 2 | L | M | N |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-------------------------------------|--------------------------|--------------------------|--------------------------|-------------------------------------|--------------------------|--------------------------|-------------------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

A Frame

| Code | Description |
|------|--|
| L | Frame size: displacements 25, 30, and 35 cm ³ [1.50, 1.83, and 2.14 in ³] |
| K | Frame size: displacements 38 and 45 cm ³ [2.32 and 2.75 in ³] |

B Mount

| Code | Description |
|------|-------------|
| V | SAE-B |
| C | Cartridge |

C1 Displacement, continuous pressure rating

| Code | Displacement | Continuous pressure rating |
|------|---------------------------|----------------------------|
| L25C | 25 cm³/rev [1.50 in³/rev] | 210 bar [3045 psi] |
| L30D | 30 cm³/rev [1.83 in³/rev] | 175 bar [2540 psi] |
| L35E | 35 cm³/rev [2.14 in³/rev] | 140 bar [2030 psi] |
| K38C | 38 cm³/rev [2.32 in³/rev] | 210 bar [3045 psi] |
| K45D | 45 cm³/rev [2.75 in³/rev] | 175 bar [2540 psi] |

C2 Speed sensing ring

| Code | Description |
|------|--|
| N | None |
| S | Speed ring installed, L Frame = 41 pulses per revolution, K Frame = 44 pulses per revolution |

D Output shaft

| Code | Description |
|------|--|
| A | 13 tooth 16/32 pitch per ANSI B92.1-1970 class 5 |
| C | 0.875 in straight key <i>(LV/KV only)</i> |
| D | 1:8 taper <i>(LV/KV only)</i> |
| E | 15 tooth 16/32 pitch per ANSI B92.1-1970 class 5 |

E1 Endcap porting

| Code | Description |
|------|---|
| R | Twin radial, 1 1/16 in-12 O-ring boss |
| Y | Axial, 1 1/16 in-12 O-ring boss <i>(LV/KV only)</i> |

E2 Loop flushing

| Code | Description |
|------|--|
| N | None (standard) |
| 1 | Flow = option 1, crack pressure 10.3 bar [150 psi] |
| 2 | Flow = option 2, crack pressure 10.3 bar [150 psi] |
| 3 | Flow = option 3, crack pressure 10.3 bar [150 psi] |

E3 Minimum angle adjustment option

| Code | Description |
|------|---------------------------|
| F | Non-adjustable fixed stop |

Reference *Loop Flushing* in
Features and options and
Technical specifications
sections.

MODEL CODE
(continued)

| | | | | | | | | | | | | | | | | | | | |
|---|---|--|----|---|---|----|---|---|---|---|---|---|----|---|---|---|---|---|---|
| A | B | | C1 | 2 | D | E1 | 2 | 3 | F | G | H | J | K1 | 2 | L | M | N | | |
| L | | | | | | | | N | F | | | | | F | | N | N | N | N |

Additional minimum
displacements are available,
contact your Sauer-Danfoss
representative for more
information

F Minimum angle/displacement setting (continued from previous page)

| Code | Angle | % of max. | L25C | L30D | L35E | K38C | K45D |
|------|-------|-----------|----------------------|----------------------|----------------------|----------------------|----------------------|
| F00 | 0 | 0% | 0 | 0 | 0 | 0 | 0 |
| F01 | 1° | 5.3% | 1.34 cm³ [0.08 in³] | 1.61 cm³ [0.09 in³] | 1.88 cm³ [0.11 in³] | 2.04 cm³ [0.12 in³] | 2.42 cm³ [0.15 in³] |
| F07 | 7° | 37.8% | 9.45 cm³ [0.58 in³] | 11.34 cm³ [0.69 in³] | 13.23 cm³ [0.81 in³] | 14.36 cm³ [0.88 in³] | 17.00 cm³ [1.04 in³] |
| F08 | 8° | 43.2% | 10.81 cm³ [0.66 in³] | 12.97 cm³ [0.79 in³] | 15.13 cm³ [0.92 in³] | 16.44 cm³ [1.00 in³] | 19.46 cm³ [1.19 in³] |
| F09 | 9° | 48.7% | 12.19 cm³ [0.74 in³] | 14.63 cm³ [0.89 in³] | 17.07 cm³ [1.04 in³] | 18.52 cm³ [1.13 in³] | 21.94 cm³ [1.34 in³] |
| F10 | 10° | 54.3% | 13.57 cm³ [0.83 in³] | 16.28 cm³ [0.99 in³] | 18.99 cm³ [1.16 in³] | 20.62 cm³ [1.26 in³] | 24.42 cm³ [1.49 in³] |
| F11 | 11° | 59.8% | 14.71 cm³ [0.90 in³] | 17.94 cm³ [1.09 in³] | 21 cm³ [1.28 in³] | 22.73 cm³ [1.39 in³] | 26.92 cm³ [1.64 in³] |

G *Control type*

| Code | Description |
|------|--|
| S | Single input hydraulic control |
| T | Dual input hydraulic control (<i>LV/KV only</i>) (<i>must use X drain orifice</i>) |

H Supply orifice

| Code | Description |
|------|-----------------|
| N | None (standard) |

J *Drain orifice*

| Code | Description |
|------|---|
| N | None (standard) |
| X | Plugged: Required for dual line hydraulic control (use when code G=T) <i>(LV/KV only)</i> |

K1 Speed sensor/connector

| Code | Description |
|------|--|
| A | None: Housing not machined for speed sensing (use when code C2=N) |
| B | None: Housing machined for speed sensor. Port plugged. |
| C | Speed sensor: 4.5–8.5 V, 4 wire directional, Weather-Pack connector, 200 mm [8 in] lead. KPPG 13408 (internal speed ring required: code C2=S). |

K2 Maximum angle adjustment option

| Code | Description |
|------|---------------------------|
| F | Non-adjustable fixed stop |

L *Maximum angle/displacement setting*

| Code | Angle | % of max. | L25C | L30D | L35E | K38C | K45D |
|------|-------|-----------|----------------------|----------------------|----------------------|----------------------|----------------------|
| F18 | 18° | 100% | 25 cm³ [1.5 in³] | 30 cm³ [1.83 in³] | 35 cm³ [2.14 in³] | 38 cm³ [2.32 in³] | 45 cm³ [2.75 in³] |
| F17 | 17° | 94.1% | 23.52 cm³ [1.44 in³] | 28.22 cm³ [1.72 in³] | 32.92 cm³ [2.01 in³] | 35.76 cm³ [2.18 in³] | 42.34 cm³ [2.58 in³] |
| F16 | 16° | 88.2% | 22.06 cm³ [1.35 in³] | 26.47 cm³ [1.62 in³] | 30.88 cm³ [1.88 in³] | 33.54 cm³ [2.05 in³] | 39.71 cm³ [2.42 in³] |
| F15 | 15° | 82.5% | 20.62 cm³ [1.26 in³] | 24.74 cm³ [1.51 in³] | — | 31.34 cm³ [1.91 in³] | 37.11 cm³ [2.26 in³] |

M Special hardware

| Code | Description |
|------|-----------------|
| NNN | None (standard) |

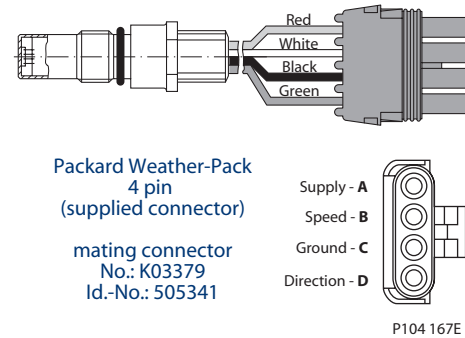
N Special features

| Code | Description |
|------|-----------------|
| NNN | None (standard) |

SPEED SENSOR

K and L Frame motors are available with an optional speed sensor. This hall-effect pick-up senses motor speed and direction of rotation via a magnetic ring mounted to the cylinder block. The sensor is available with a 4-pin Packard Weather-Pack connector. Specifications appear below. For more information, refer to *Technical Bulletin, KPP Pulse Pick-up*, **BLN-95-9045**.

KPP Pulse Pick-up with Weather-Pack connector



Specifications

| | |
|-------------------------------|---|
| Supply voltage | 4.5 to 8.5 VDC (regulated) |
| Output voltage (high) | Supply minus 0.5VDC, minimum (no load) |
| Output voltage (low) | 0.5 VDC Maximum (no load) |
| Maximum frequency | 15 kHz |
| Max. operating current | 20 mA at 1 kHz |
| Load | 15 k Ω to both ground and supply |
| Peak reverse voltage | -15 VDC continuous |
| Peak transient voltage | 80 VDC for 2 ms (max.) |
| Pulses per rev. | 41 (LV motor) 44 (KV motor) |

OUTPUT SHAFTS

L and K Frame variable motors are available with splined, tapered, and straight-keyed shafts. See the following page for details.

Lubrication of splined shafts

Splined shaft couplings require lubrication to minimize corrosion, fretting, and premature wear. Flooded or splashed oil lubrication is ideal. In applications where this is not possible, Sauer-Danfoss recommends you apply a compound of 50% high temperature grease and 50% molybdenum disulfide powder to the splines during installation and at regular intervals during service life. This lubricant is not soluble in oil.

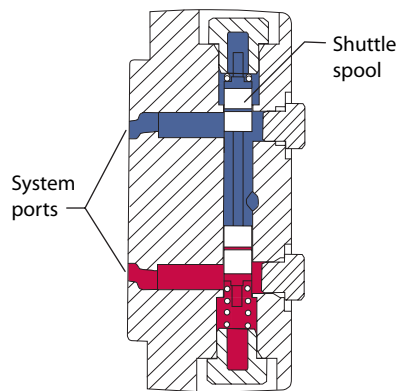
LOOP FLUSHING

K and L motors incorporate an optional integral loop flushing valve. Use the loop flushing valve in circuits requiring the removal of excessive contamination or installations that require the removal of additional fluid from the main hydraulic circuit due to cooling requirements.

K and L motors equipped with an integral loop flushing shuttle valve also include a loop flushing relief valve. The loop flushing relief valve poppet includes an orifice which controls flushing flow. Flushing flow. Use a loop flushing flow of 5 to 8 L/min (1.5 - 2 gpm) is typical.

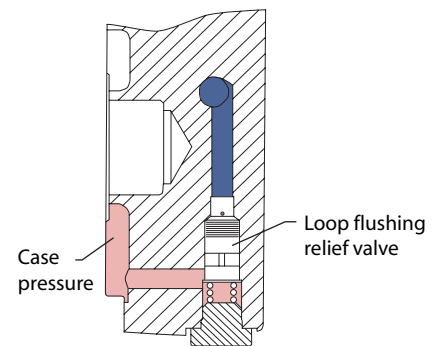
The opening pressure (indicated in graph below) of the loop flushing relief valve should be equal to or less than the charge pressure setting of the pump. Contact your Sauer-Danfoss representative for assistance.

Loop Flushing valve



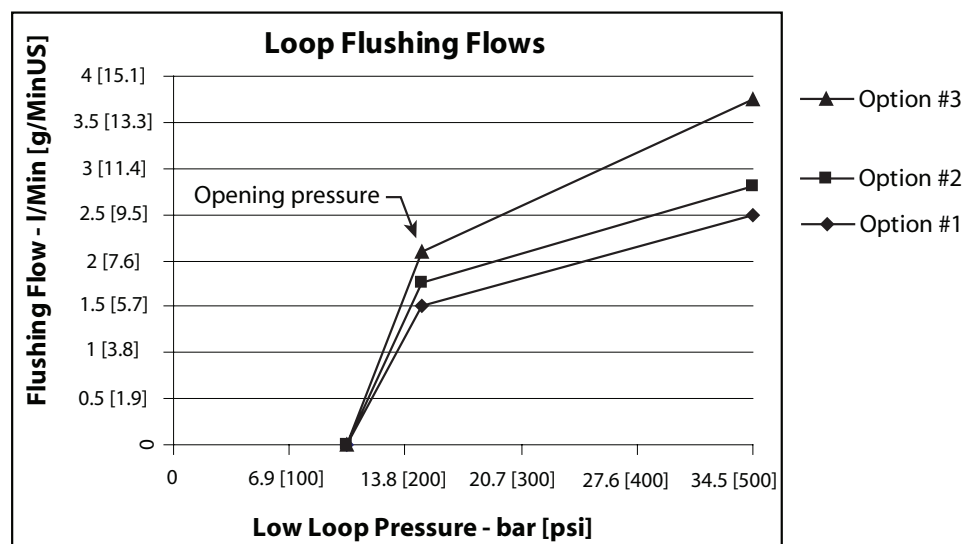
P106 493E

Relief valve



P106 494E

Loop Flushing flow

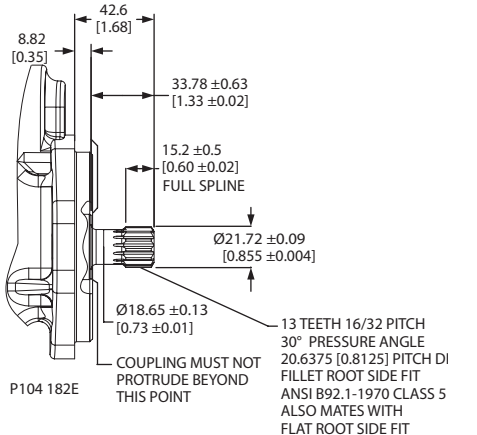
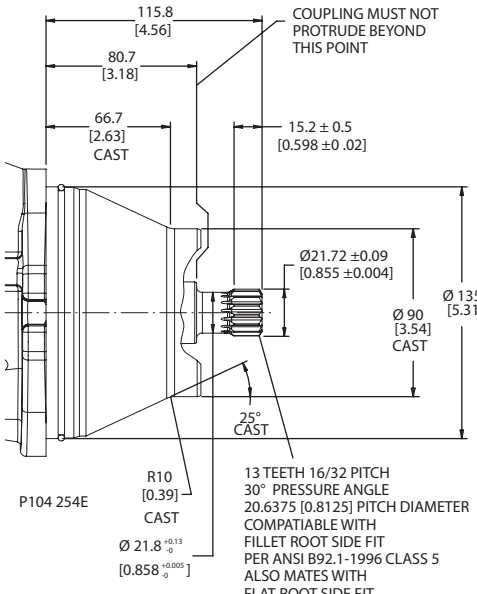
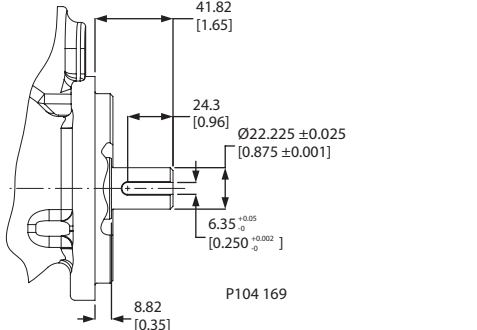


P106 496E

OUTPUT SHAFTS

(continued)

Shaft options

| Code | Description | Availability | | Torque rating | | Drawing |
|------|---|--------------|-------|---|-------------------------|--|
| | | LV/KV | LC/KC | Continuous N·m [lbf·in] | Maximum N·m [lbf·in] | |
| A | 13 tooth spline 16/32 pitch ANSI B92.1 1970-Class 5 | I | — | 73 [650] (Continuous torque rating based on spline tooth wear) | 226 [2000] |  |
| A | 13 tooth spline 16/32 pitch ANSI B92.1 1970-Class 5 | — | I | 73 [650] (Continuous torque rating based on spline tooth wear) | 226 [2000] |  |
| C | Ø 22.225 mm [0.875 in] Straight keyed | I | — | N/A | 362 [3200] |  |

OUTPUT SHAFTS
(continued)

| Code | Description | Availability | | Torque rating | | Drawing |
|------|---|--------------|-------|---|-------------------------|--|
| | | LV/KV | LC/KC | Continuous N·m [lbf·in] | Maximum N·m [lbf·in] | |
| D | Ø 22.225 mm [0.875 in] 1:5 Taper | I | — | N/A | 362 [3200] | <p>P104 168</p> |
| E | 15 tooth spline 16/32 pitch ANSI B92.1 1970-Class 5 | I | — | 153 [1350] (Continuous torque rating based on spline tooth wear) | 362 [3200] | <p>P104 170E</p> |
| E | 15 tooth spline 16/32 pitch ANSI B92.1 1970-Class 5 | — | I | 153 [1350] (Continuous torque rating based on spline tooth wear) | 362 [3200] | <p>P104 174E</p> <p>COUPLING MUST NOT PROTRUDE BEYOND THIS POINT</p> <p>15 TEETH 16/32 PITCH 30° PRESSURE ANGLE 23.813 [0.9375] PITCH DIAMETER COMPATIBLE WITH FILLET ROOT SIDE FIT PER ANSI B92.1-1996 CLASS 5 ALSO MATES WITH FLAT ROOT SIDE FIT</p> |

DISPLACEMENT LIMITERS

L and K Frame variable motors can be equipped with optional fixed (non-adjustable) displacement limiters. Refer to *Maximum angle/Displacement setting*, page 17, for available displacement settings.

MOTOR ROTATION

L and K Frame variable motors are fully bidirectional. The chart to the right gives the direction of rotation with respect to flow direction through the motor.

Rotation by flow direction

| Mount | SAE-B | Cartridge |
|----------|-------|-----------|
| Flow A→B | CCW | CW |
| Flow B→A | CW | CCW |

CONTROLS

L and K Frame variable motors are designed to operate in two positions: maximum and minimum displacement. The motors are spring biased to maximum displacement and hydraulically shifted to minimum displacement. SAE-B mount motors can operate with a single or dual line control. Cartridge mount motors operate with a single line control. Pressure applied at port X1 shifts the motor to minimum displacement. Pressure at X2 (dual line control) can assist the shift to maximum displacement. Refer to the table above for control input pressure range.

Control input pressure limits

| | |
|--------------------------------|------------------------------------|
| LV/KV with single line control | 14 to 240 bar [200 to 3500 psi] |
| LV/KV with dual line control | 14 to 35 bar [200 to 500 psi] |
| LC/KC with single line control | 14 to 69 bar [200 to 1000 psi] |

Control orificing

SAE-B mount motors with single line controls can have optional, internal, supply and drain orifices installed to regulate control response times. Contact your Sauer-Danfoss representative for available orifice sizes.

Cartridge mount motors and SAE-B mount motors with dual line controls rely on external valving and orificing to regulate shift speeds. You can achieve quick acceleration (shift to min) and slow deceleration (shift to max) simply by installing an orifice in the tank line of the external control valve.

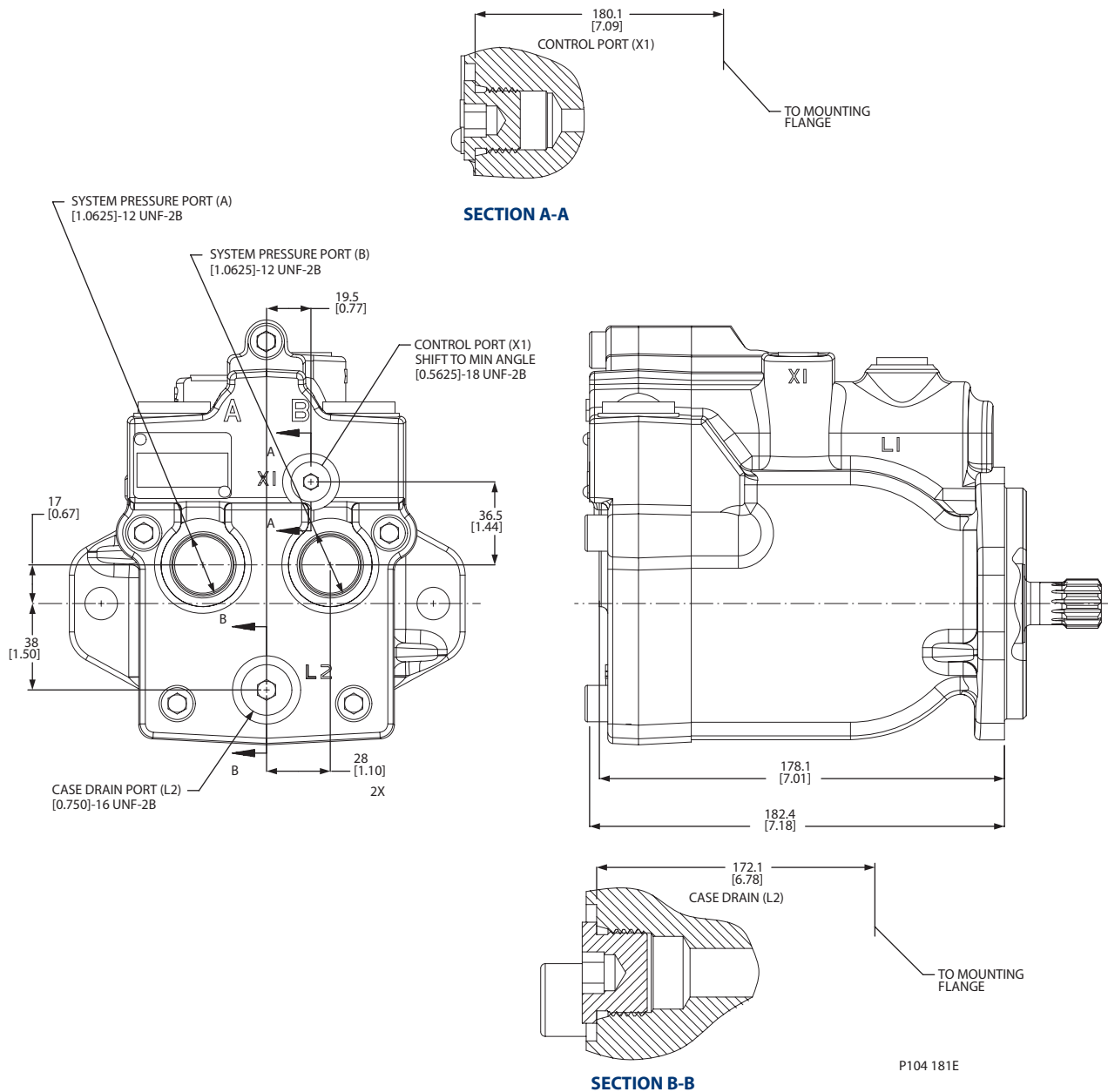
BRAKE RELEASE PORT (CARTRIDGE MOTORS)

Cartridge mount motors are equipped with a brake release port to allow access to the brake-release feature of the gear box from the rear of the motor. This consists of a simple passage through the motor housing with a rear-facing $\frac{7}{16}$ in. SAE O-ring boss port. To locate the port on the gear box, refer to the *Installation drawings*, page 26. Applications using this brake release port require an O-ring to seal the passage against the gear box.

While all motors will have the brake release port, not all gearboxes are compatible with this motor feature. Consult your gearbox manufacturer for suitability and compatibility. If your gearbox is not compatible with this feature, simply leave the port plugged.

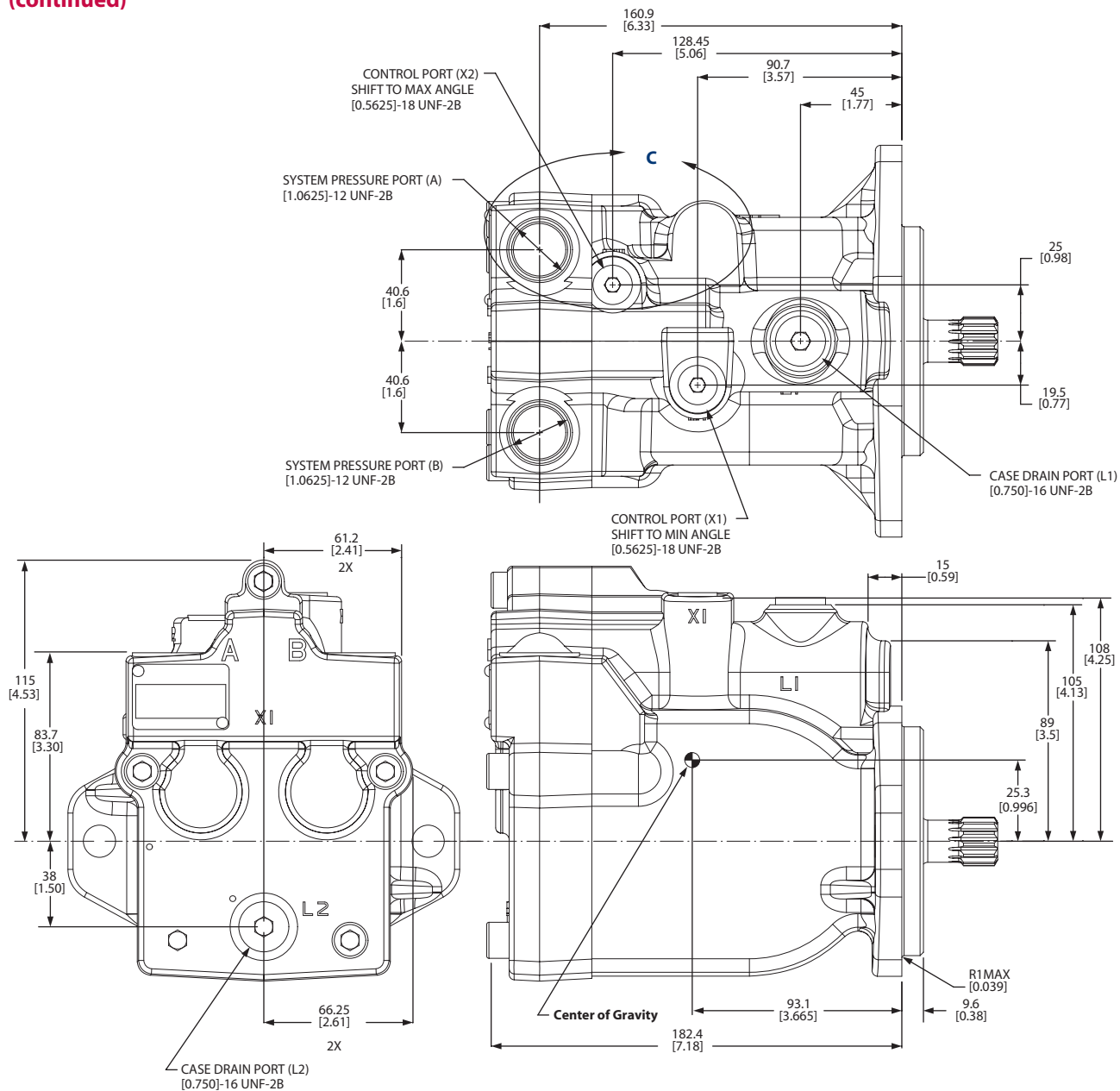
SAE-B MOUNT (LV/KV)

Axial ports

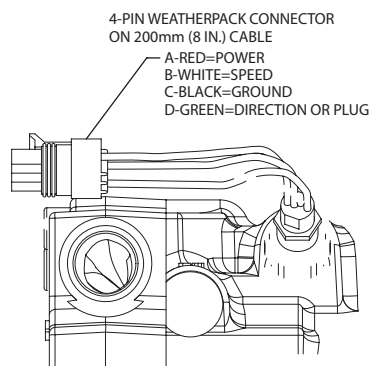


SAE-B MOUNT (LV/KV)
(continued)

Radial ports

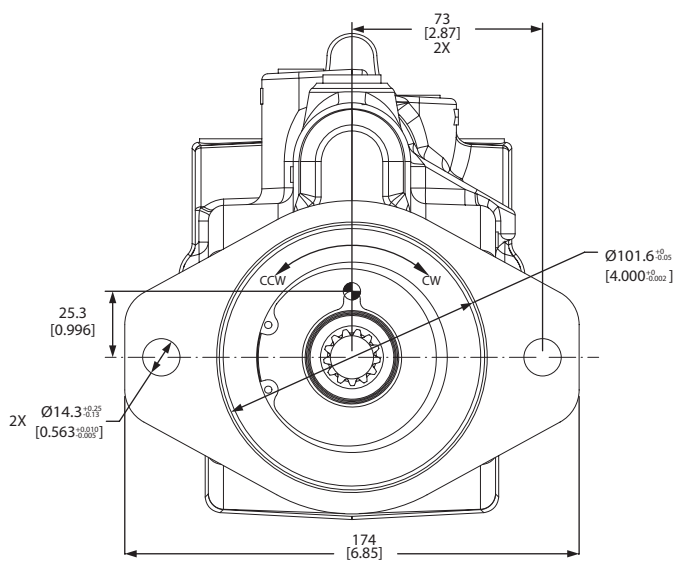


SAE-B MOUNT (LV/KV)
(continued)



VIEW C

Motor with speed sensor



P104 180E

Recommended mounting hardware

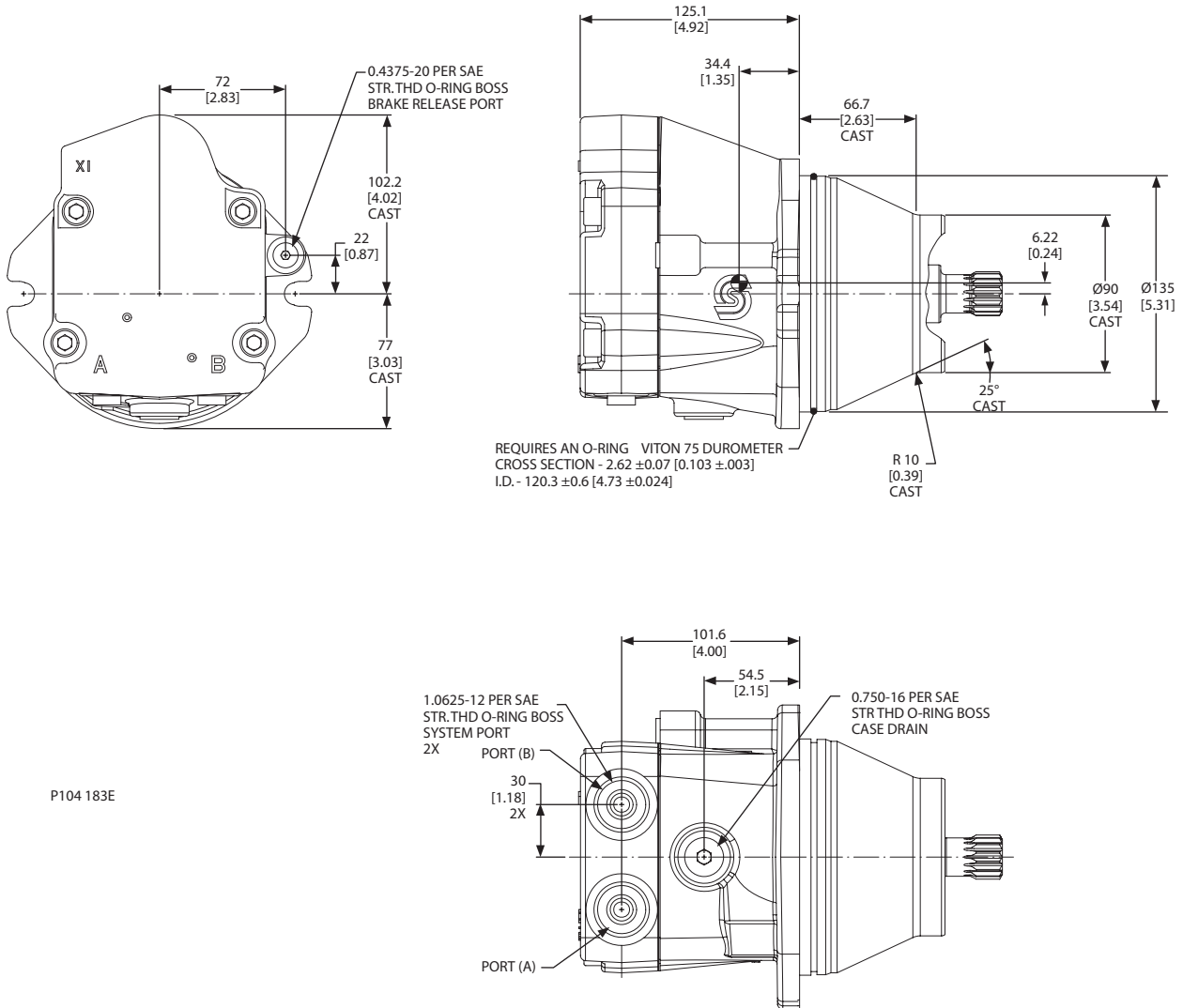
| Bolt size | Grade | Torque N•m [lbf•ft] |
|-----------|-------|---------------------|
| 1/2 in. | 5 | 86 [64] |
| | 8 | 122 [90] |

Use hardened washer under each bolt head.



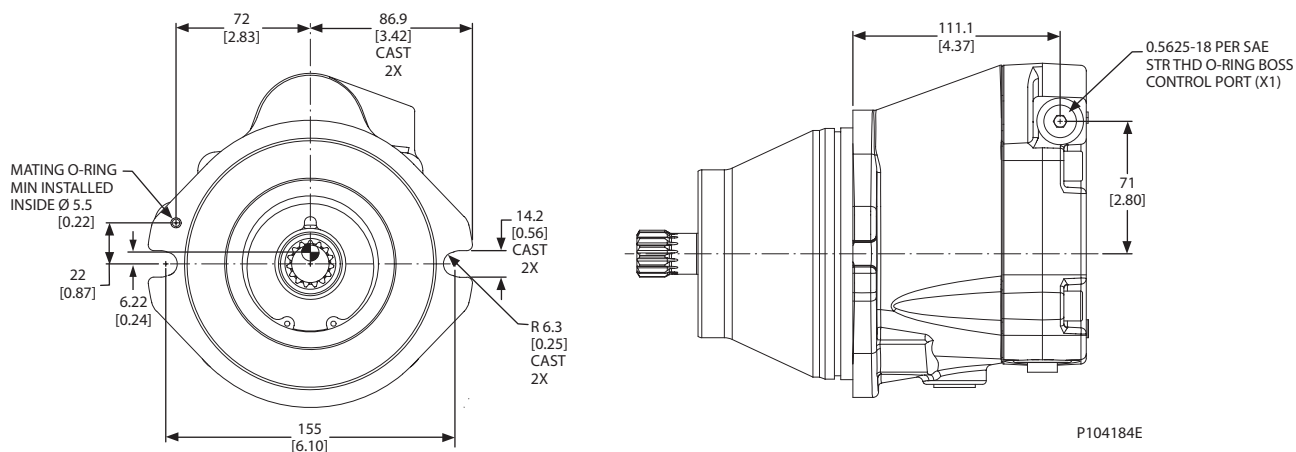
CARTRIDGE (LC/KC)

Radial ports



P104 183E

CARTRIDGE (LC/KC)
(continued)



Recommended mounting hardware

| Recommended mounting hardware | | | |
|---|-------|---------------------|--------------------------|
| Bolt size | Grade | Torque N·m [lbf·ft] | Mounting circle diameter |
| 1/2 in. | 5 | 86 [64] | 160 mm [6.299 in] |
| | 8 | 122 [90] | |
| Use hardened washer under each bolt head. | | | |

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Local address:

Sauer-Danfoss (US) Company
 2800 East 13th Street
 Ames, IA 50010, USA
 Phone: +1 515 239-6000
 Fax: +1 515 239-6618

Sauer-Danfoss GmbH & Co. OHG
 Postfach 2460, D-24531 Neumünster
 Krokamp 35, D-24539 Neumünster, Germany
 Phone: +49 4321 871-0
 Fax: +49 4321 871 122

Sauer-Danfoss ApS
 DK-6430 Nordborg, Denmark
 Phone: +45 7488 4444
 Fax: +45 7488 4400

Sauer-Danfoss-Daikin LTD
 Sannomiya Grand Bldg. 8F
 2-2-21 Isogami-dori, Chuo-ku
 Kobe, Hyogo 651-0086, Japan
 Phone: +81 78 231 5001
 Fax: +81 78 231 5004