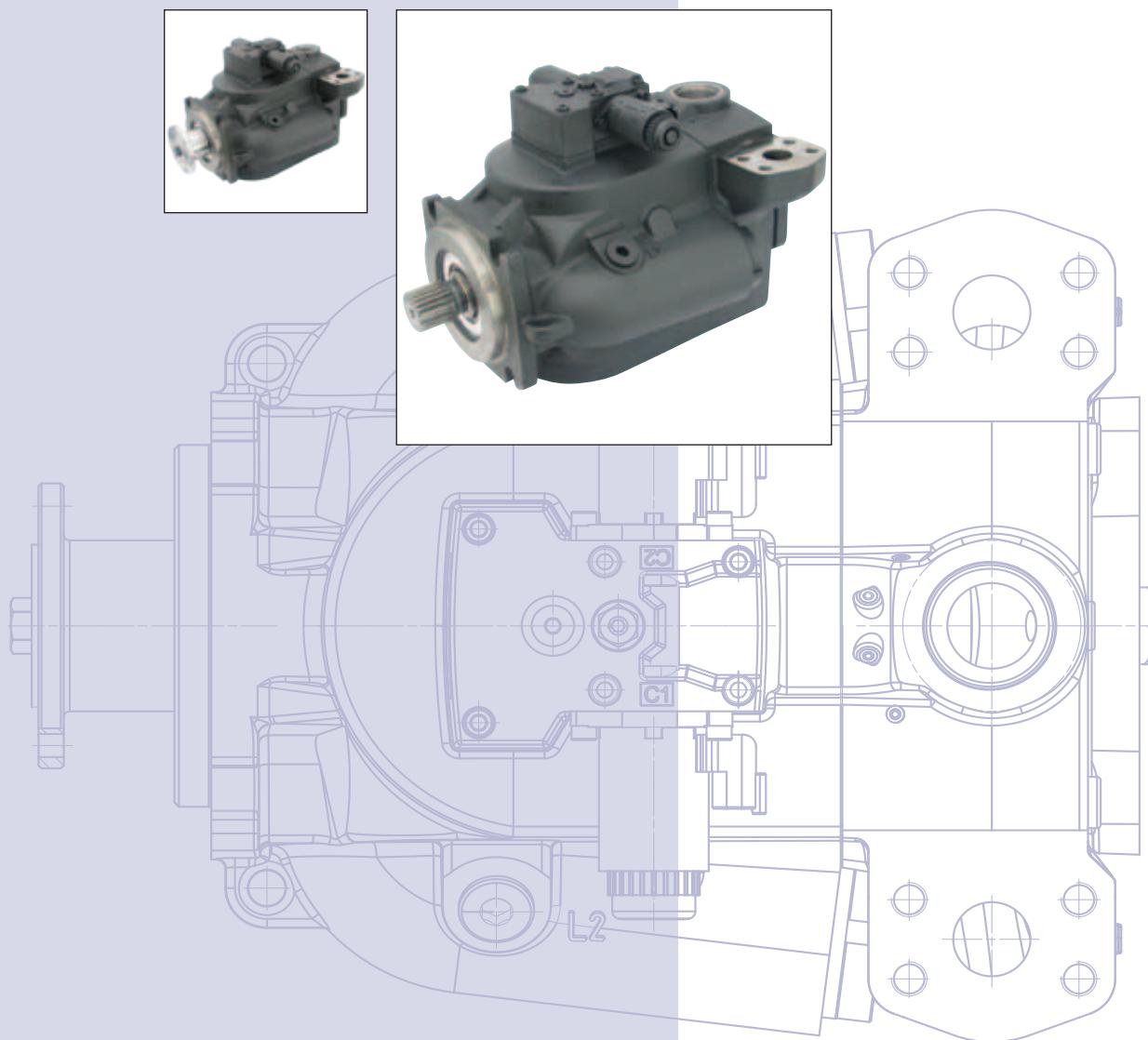




Series TM
Transit Mixer
Axial Piston Pump
Size 070/089

**Technical
Information**



Series **TM** Transit Mixer Axial Piston Pump, Size 070/089

Technical Information

Revisions

Revision History

Table of revisions

| Date | Page | Changed | Rev |
|--------------|-----------|---|-----|
| 24 Jun, 2010 | — | First edition | AA |
| 24 Aug, 2010 | 44 | New Backpage | AB |
| 13 Sep, 2010 | 16 | Table data for "Control current" | AC |
| 12 Jul, 2011 | All | Major update. | BA |
| 26 Sep, 2011 | 14 | MMC change - option "G" added, 3 "Special Hardware" deleted | BB |
| 14 Oct, 2011 | 6, 15, 18 | Images and table data change | BC |

Reference Literature

Further available literature

| Description | SD order number |
|---|-----------------|
| TMP Axial Piston Pump, Size 070/089; Technical Information | L1006391 |
| Speed and Temperature Sensor; Technical Information | 11046759 |
| Hydraulic Fluids and Lubricants, Technical Information | 520L0463 |
| Design Guideline for Hydraulic Fluid Cleanliness, Technical Information | 520L0467 |
| H1 Electrical Displacement Control (EDC), Technical Information | 11022744 |
| TMP Axial Piston Pump, Size 070/089, Single; Service Manual | L1010109 |

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General Information

General Description

The TMP - axial variable displacement pump is designed primarily to be combined with other motors in closed circuit systems to transfer hydraulic power. It is a compact and high power density pump with integral electro-hydraulic control which regulates rate (speed) and direction of the hydraulic flow. The pump is designed especially for transit mixer applications, where the unique user-friendly design provides simple assembling and service for customers.

Features

- Innovative reliable design, using the latest technology
- All interfaces accessible from one side (top)
- Load independent displacement control / Electric Displacement Control (EDC)
- Flange, spline and coupling shaft-configurations available
- Proven rotating group reliability based on Series 20 technology
- Integrated high pressure relief valves
- Optional speed sensor
- Optional integrated speed and temperature sensor
- Available metric connections
- 70 cm³ and 89 cm³ displacements available
- TMP is compatible with the Sauer-Danfoss family of PLUS+1™ compliance technology for easy 'Plug-and-Perform' installation.



Name Plate

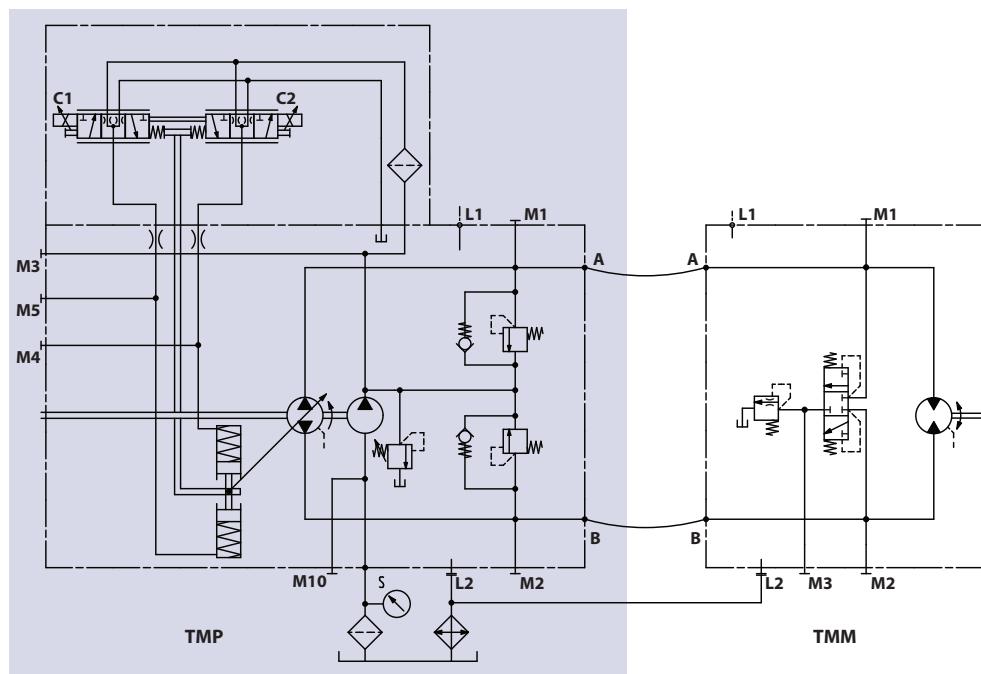
Name plate description



System Schematic

The schematic below shows the function of a hydrostatic transmission using a TMP axial variable displacement pump with electric proportional displacement control (EDC) and a TMM fixed displacement motor with integrated loop flushing device.

TMP with TMM



Port description

| | |
|------------|-----------------------------------|
| A | System port "A" |
| B | System port "B" |
| L1 | Case drain port |
| L2 | Case drain port |
| M1 | System A gage port |
| M2 | System B gage port |
| M3 | Charge gage port, after filtering |
| M4 | Servo gage port |
| M5 | Servo gage port |
| M10 | Charge pump inlet pressure |
| S | Charge inlet port |

Detailed information about ports see the section *Installation drawings*, pages 28-29.

Technical Specification
General specifications

| | |
|--|--|
| Design | Axial piston pump cradle swashplate design with variable displacement |
| Direction of rotation | Clockwise, counterclockwise |
| Pipe connections | Main pressure ports: ISO split flange boss Remaining ports: ISO straight thread O-ring boss |
| Recommended installation position | Pump installation position is discretionary; however the recommended control position is on the top. The housing must always be filled with hydraulic fluid. Pump shaft connection is discretionary, however it is strongly recommended to use rubber coupling if pump is driven via "cardan" shaft. Correct installation has a significant influence on a life time of the pump. |

Caution

The front shaft seal must not be exposed to oil pressure from outside of the unit.

Technical data

| Features | Unit | Size | |
|---|--|--------------------|--------------------|
| | | 070 | 089 |
| Displacement maximum | cm ³ [in ³] | 68.3 [4.17] | 89.0 [5.43] |
| Flow at rated (continuous) speed | l/min [US gal/min] | 171 [45.2] | 222.5 [58.8] |
| Torque at maximum displacement (theoretical) | N·m/bar [lbf·in/1000 psi] | 1.09 [665] | 1.42 [867] |
| Mass moment of inertia of rotating components | kg·m ² [lbf·ft ²] | 0.0209 [0.0159] | 0.0209 [0.0159] |
| Weight dry (standard) | kg [lb] | 61 [135] | 61 [135] |
| Oil volume | l [US gal] | 2 [0.53] | 2 [0.53] |
| Mounting flange | SAE ISO 3019/1 flange 127-4 (SAE C), M12x1,75 | | |
| Input shaft | Spline shaft SAE, 21 teeth, pitch = 16/32 Spline shaft SAE, 23 teeth, pitch = 16/32 Coupling flange Ø100 mm for Cardan, 23 teeth (only with spline shaft SAE, 23 teeth, pitch = 16/32) Cardan flange Ø100 mm | | |
| Auxiliary mounting flange with metric fasteners, shaft splines | SAE A, 11 teeth, pitch = 16/32 SAE B, 13 teeth, pitch = 16/32 SAE B-B, 15 teeth, pitch = 16/32 | | |
| Suction port | ISO 6149-1 – M42x2 (O-ring boss) | | |
| Main port configuration | Twin ports SAE J518b Size 1, with metric screws M12 | | |
| Case drain ports L1, L2 | ISO 6149-1 – M22x1,5 (O-ring boss) | | |
| Other ports | ISO 6149-1 straight thread O-ring boss. See <i>Installation drawings</i> , pages 28-29. | | |

Series TM Transit Mixer Axial Piston Pump, Size 070/089

Technical Information

Technical Specifications

Technical Specifications (continued)

Operating parameters

| Features | | Unit | Size |
|----------------------------|--------------------------------------|----------------------------------|------------|
| | | | 070 / 089 |
| Input speed | Minimum | min ⁻¹ (rpm) | 500 |
| | Rated | | 2500 |
| | Maximum | | 2900 |
| System pressure | Max. working pressure | bar | 420 [6090] |
| | Maximum pressure | | 450 [6525] |
| | Minimum pressure | | 10 [145] |
| Charge pressure | Minimum | bar [psi] | 17 [247] |
| | Maximum | | 30 [436] |
| Control pressure | Minimum (at corner power for EDC) | | 21 [305] |
| | Maximum | | 30 [435] |
| | Rated | | 0.7 [9] |
| Charge pump inlet pressure | Minimum (cold start) | bar (absolute) [in Hg vacuum] | 0.2 [24] |
| | Maximum | | 4.0 [58] |
| | Rated | | 3.0 [44] |
| Case pressure | Maximum | bar [psi] | 5.0 [73] |
| | Maximum | | 0.4 [5.8] |

Fluid specifications

| Features | | Unit | Sizes 070 / 089 |
|----------------------------------|---|-----------------------------|---|
| Viscosity | Intermittent 1) | mm ² /s [SUS] | 5 [42] |
| | Minimum | | 7 [49] |
| | Recommended range | | 12-80 [66-370] |
| | Maximum | | 1600 [7500] |
| Temperature range 2) | Minimum (cold start) 3) | °C [°F] | -40 [-40] |
| | Recommended range | | 60-85 [140-185] |
| | Rated | | 104 [220] |
| | Maximum intermittent 1) | | 115 [240] |
| Filtration (recommended minimum) | Cleanliness per ISO 4406 | β-ratio | 22/18/13 |
| | Efficiency (charge pressure filtration) | | $\beta_{15-20} = 75$ ($\beta_{10} \geq 10$) |
| | Efficiency (suction and return line filtration) | | $\beta_{35-45} = 75$ ($\beta_{10} \geq 2$) |
| | Recommended inlet screen mesh size | μm | 100 – 125 |

1) Intermittent = Short term t < 1 min per incident and not exceeding 2 % of duty cycle based load-life

2) At the hottest point, normally case drain port

3) Cold start = Short term t < 3 min, p ≤ 50 bar [725 psi], n ≤ 1000 min⁻¹(rpm)

Technical Specifications (continued)

Input Speed

Minimum speed is the lowest input speed recommended during engine idle condition. Operating below minimum speed limits the pump's ability to maintain adequate flow for lubrication and power transmission.

Rated speed is the highest input speed recommended at full power condition. Operating at or below this speed should yield satisfactory product life.

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

System Pressure

Maximum working pressure is the highest recommended application pressure; and it is not intended to be a continuous pressure. Propel systems with application pressures at, or below, this pressure should yield satisfactory unit life given proper component sizing.

Maximum pressure is the highest allowable application pressure under any circumstance. Application pressures above maximum working pressure will only be considered with duty cycle analysis and factory approval.

Minimum pressure must be maintained under all operating conditions to avoid cavitation.

Charge Pressure

Minimum charge pressure is the lowest pressure allowed to maintain a safe working condition in the low side of the loop.

Maximum charge pressure is the highest charge pressure allowed by the charge relief adjustment, which provides normal component life.

Charge Pump Inlet Pressure

At normal operating temperature, charge inlet pressure must not fall below rated charge inlet pressure (vacuum).

Minimum charge inlet pressure is only allowed at cold start conditions. In some applications it is recommended to warm up the fluid (e.g. in the tank) before starting the engine and then run the engine at limited speed.

Maximum charge pump inlet pressure may be applied continuously.

Case Pressure

Under normal operating conditions, the rated case pressure must not be exceeded. During cold start, case pressure must be kept below maximum intermittent case pressure.

External Shaft Seal Pressure

In certain applications, the input shaft seal may be exposed to external pressures. The shaft seal is designed to withstand an external pressure up to 0.4 bar [5.8 psi] above the case pressure.

The case pressure limits must also be followed to ensure the shaft seal is not damaged.

**Technical Specifications
(continued)****Temperature**

High temperature limits apply at the inlet port of the motor. The motor should run at or below the maximum continuous temperature.

Cold oil generally does not affect the durability of motor components. It may affect the ability of oil to flow and transmit power. For this reason, keep the temperature at 16°C [60 °F] above the pour point of the hydraulic fluid.

Minimum (cold start) **temperature** relates to the physical properties of component materials.

Maximum continuous temperature is the allowed temperature at which normal life can be expected.

Peak (intermittent) **temperature**: the overheating temperature that is tolerable by the machine for a transient/limited time.

Viscosity

Minimum viscosity occurs only during brief occasions of maximum ambient temperature and severe duty cycle operation. It's the minimum acceptable viscosity to allow normal motor life.

Maximum viscosity occurs only during cold start at very low ambient temperatures. It's the upper limit of viscosity that allows the motor to start.

Temperature and viscosity requirements must be concurrently satisfied.
Use petroleum/mineral-based fluids.

**Technical Specifications
(continued)****Filtration**

To prevent premature wear, ensure only clean fluid enters the hydrostatic transmission circuit. A filter capable of controlling the fluid cleanliness to ISO 4406 class 22/18/13 (SAE J1165) or better, under normal operating conditions, is recommended. These cleanliness levels can not be applied for hydraulic fluid residing in the component housing/case or any other cavity after transport.

Filtration strategies for TMP include only suction filtration. The selection of a filter depends on a number of factors including the contaminant ingress rate, the generation of contaminants in the system, the required fluid cleanliness, and the desired maintenance interval. Filters are selected to meet the above requirements using rating parameters of efficiency and capacity.

Filter efficiency can be measured with a Beta ratio¹ (β_x). For simple suction-filtered closed circuit transmissions and open circuit transmissions with return line filtration, a filter with a β -ratio within the range of $\beta_{35-45} = 75$ ($\beta_{10} \geq 2$) or better has been found to be satisfactory. For some open circuit systems, and closed circuits with cylinders being supplied from the same reservoir, a considerably higher filter efficiency is recommended. This also applies to systems with gears or clutches using a common reservoir. For these systems, a charge pressure or return filtration system with a filter β -ratio in the range of $\beta_{15-20} = 75$ ($\beta_{10} \geq 10$) or better is typically required. Because each system is unique, only a thorough testing and evaluation program can fully validate the filtration system. Please see *Design Guidelines for Hydraulic Fluid Cleanliness Technical Information*, **520L0467** for more information.

¹ Filter β_x -ratio is a measure of filter efficiency defined by ISO 4572. It is defined as the ratio of the number of particles greater than a given diameter ("x" in microns) upstream of the filter to the number of these particles downstream of the filter.

Case Drain

All TM pumps are equipped with two case drain ports. Port selection and case drain routing must enable the pump housing to maintain a volume of oil not less than half full and normal operating case pressure limits of the unit are maintained. Case drain routing and design must consider unit case pressure ratings.

A case drain line must be connected to one of the case outlets to return internal leakage to the system reservoir.

Reservoir

The **reservoir** provides clean fluid, dissipates heat, removes entrained air, and allows for fluid volume changes associated with fluid expansion during system operation. A correctly sized reservoir also accommodates maximum volume changes during all system operating modes. It promotes de-aeration of the fluid as it passes through, and accommodates a fluid dwell-time between 60 and 180 seconds, allowing entrained air to escape.

Minimum reservoir capacity depends on the volume required to cool and hold the oil, allowing for expansion due to temperature changes. A fluid volume of one to three times the motor output flow (per minute) is satisfactory. The minimum recommended reservoir capacity is 125% of the fluid volume.

Put the return-line below the lowest expected fluid level to allow discharge into the reservoir for maximum dwell and efficient de-aeration. A baffle (or baffles) between the return and suction lines promotes de-aeration and reduces fluid surges.

**Determination of
Nominal Pump Sizes**

Use these formulae to determine the nominal pump size for a specific application:

Based on SI units

Based on US units

Output flow: $Q = \frac{Vg \cdot n \cdot \eta_v}{1000}$ l/min

$Q = \frac{Vg \cdot n \cdot \eta_v}{231}$ [US gal/min]

Input torque: $M = \frac{Vg \cdot \Delta p}{20 \cdot \pi \cdot \eta_m}$ N·m

$M = \frac{Vg \cdot \Delta p}{2 \cdot \pi \cdot \eta_m}$ [lbf·in]

Input power: $P = \frac{M \cdot n}{9550} = \frac{Q \cdot \Delta p}{600 \cdot \eta_t}$ kW

$P = \frac{M \cdot n}{63.025} = \frac{Q \cdot \Delta p}{1714 \cdot \eta_t}$ [hp]

Variables: SI units [US units]

V_g = Displacement per rev. cm^3/rev [in^3/rev]

p_{HD} = Outlet pressure bar [psi]

p_{ND} = Inlet pressure bar [psi]

Δp = $p_{HD} - p_{ND}$ bar [psi]

n = Speed min^{-1} (rpm)

η_v = Volumetric efficiency

η_m = Mechanical (torque) efficiency

η_t = Overall efficiency ($\eta_v \cdot \eta_m$)

Series **TM** Transit Mixer Axial Piston Pump, Size 070/089
 Technical Information
Technical Specifications

Master Model Code



| | |
|------------|--------------------|
| TMP | Transit Mixer Pump |
|------------|--------------------|

B Frame size / Displacement

| | |
|------------|---|
| 070 | 68.3 cm ³ /rev [4.17 in ³ /rev] |
| 089 | 89.0 cm ³ /rev [5.43 in ³ /rev] |

C Control

| | |
|----------------|--|
| EDC024A | Electrical Displacement Control (EDC) - (24 V) with Manual Over Ride |
| EDC012A | Electrical Displacement Control (EDC) - (12 V) with Manual Over Ride |

D Sense of rotation

| | |
|----------|------------------------------|
| R | Right hand (clockwise) |
| L | Left hand (counterclockwise) |

G End cap ports; High pressure setting

| | |
|------------|--|
| M42 | Endcap Ports: DN 25, Type 2, 420 bar (6000 PSI), ISO 6162-2; High pressure relief valve 420 bar, (Metric connections) |
| M28 | Endcap Ports: DN 25, Type 2, 420 bar (6000 PSI), ISO 6162-2; High pressure relief valve 280 bar, (Metric connections) |

H Charge pump; Charge pump relief valve setting

| | |
|--------------|--|
| 20G22 | Charge pump: 20 cm ³ /rev; Charge pump relief valve settings: 20.3-22.5 bar |
|--------------|--|

J Auxiliary Mounting Pad

| | |
|----------|---|
| A | ISO 3019-1, flange 82 - 2, (SAE A, 9 teeth 16/32) |
| B | ISO 3019-1, flange 101 - 2, (SAE B, 13 teeth 16/32) |
| V | ISO 3019-1, flange 101 - 2, (SAE B-B, 15 teeth 16/32) |
| N | none |

L Shaft

| | |
|----------|---|
| C | Splined shaft, 23 teeth, pitch = 16/32 |
| D | Splined shaft, 21 teeth, pitch = 16/32 |
| F | Cardan flange ø100 mm |
| G | 'C' Shaft option, Added Coupling 23 teeth with flange ø100 mm |

W Special Hardware Features

| | |
|------------|--|
| NCN | No sensor, Valve plate CP30 |
| HCN | Speed & Temperature sensor 53 impulsions (n, direc. T), Valve plate CP30 |
| ACN | KPP156 speed sensor (n, direc.), Valve plate CP30 |

F Special Features

| | |
|------------|---|
| NSN | No paint, Name plate "Slovakia" |
| NDN | No paint, Name plate "Sauer-Danfoss" |
| BSN | Black paint, Name plate "Slovakia" |
| BDN | Black paint, Name plate "Sauer-Danfoss" |
| GSN | Gray paint, Name plate "Slovakia" |
| GDN | Gray paint, Name plate "Sauer-Danfoss" |

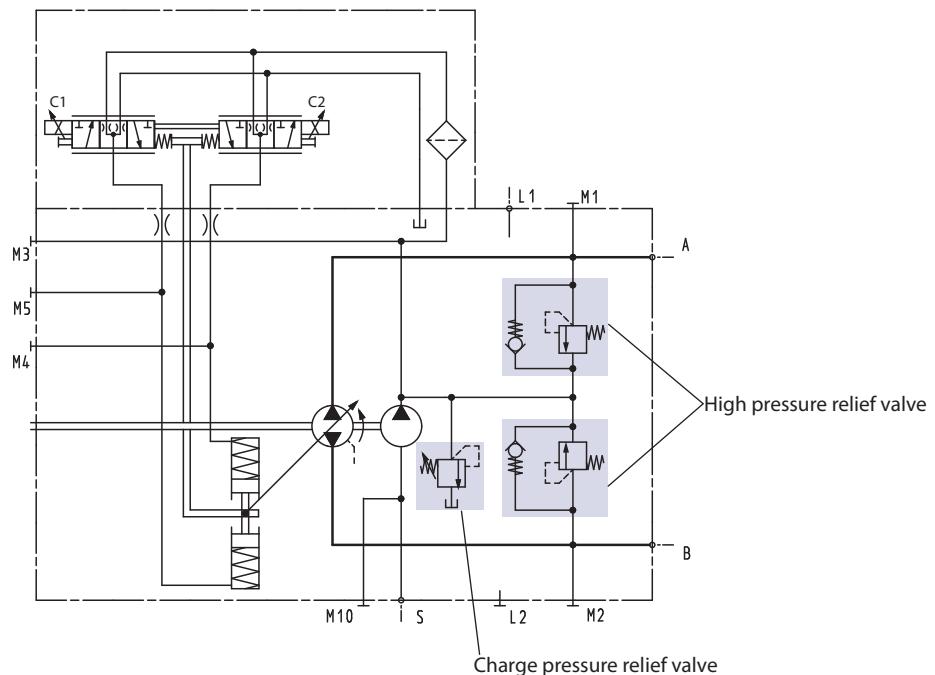
Technical Specifications

High Pressure Relief Valve (HPRV)

The TM pumps are equipped with a combination high pressure relief and charge check valve. The high-pressure relief function is a dissipative pressure control valve for the purpose of limiting excessive system pressures. The charge check function acts to replenish the low-pressure side of the working loop with charge oil. Each side of the transmission loop has a dedicated HPRV valve that is non-adjustable with a factory set pressure. When system pressure exceeds the factory setting of the valve, oil is passed from the high pressure system loop into the charge gallery, and into the low pressure system loop via the charge check.

The pump order code allows for different pressure settings to be used at each system port.

System schematic, single pump



Charge Pressure Relief Valve (CPRV)

The charge pressure relief valve maintains charge pressure at a designated level above case pressure. The charge pressure relief valve is a direct acting poppet valve which opens and discharges fluid to the pump case when pressure exceeds a designated level. Standard level setting is $\Delta p = 21 \pm 1.1$ bar [304 \pm 16 psi] with the pump running at 1500 rpm and flow = 23.80 - 29.5 l/min [6.3 - 7.8 US gal/min].

Typical charge pressure increase is 2 bar per 10 l/min [29 psi per 2.64 US gal/min].

Charge Pump

Charge flow is required on all pumps applied in closed circuit installations. The charge pump provides flow to make up internal leakage, maintain a positive pressure in the main circuit, provides flow for cooling and filtration, replaces any leakage losses from external valving or auxiliary systems, and provides flow and pressure for the control system.

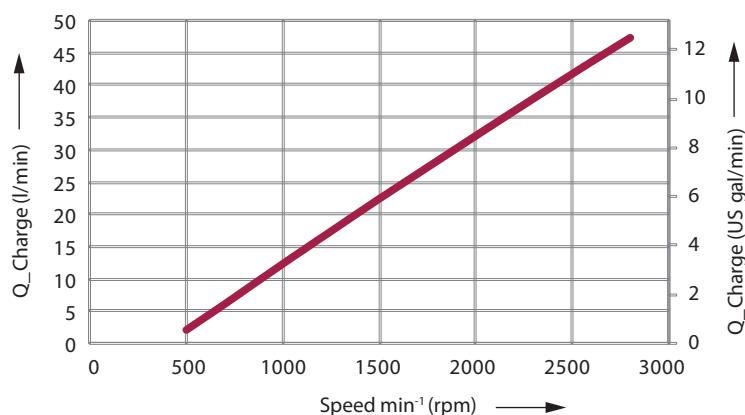
Charge pump flow and power curves

Charge pressure: 20 bar [290 psi]

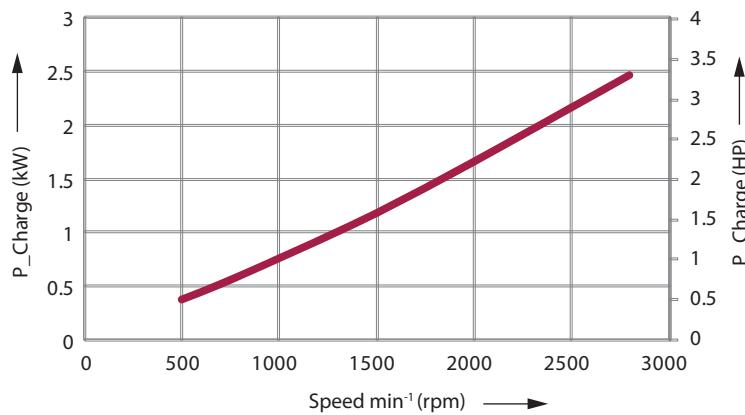
Viscosity: 11 mm²/s [63 SUS]

Temperature: 80 °C [180 °F]

Charge pump flow

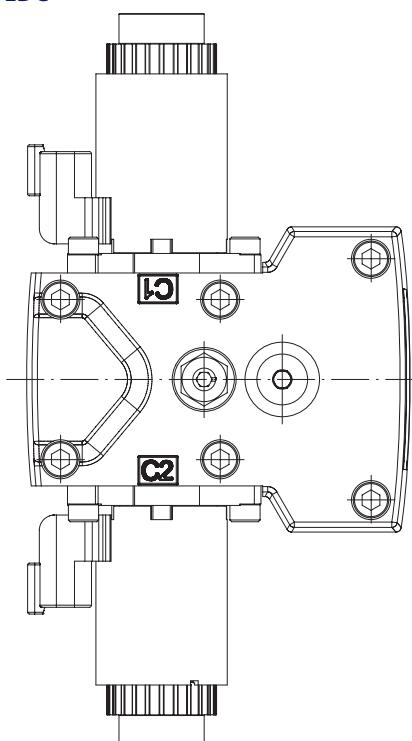
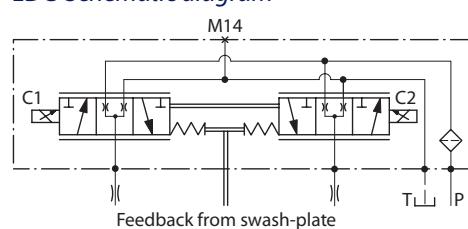
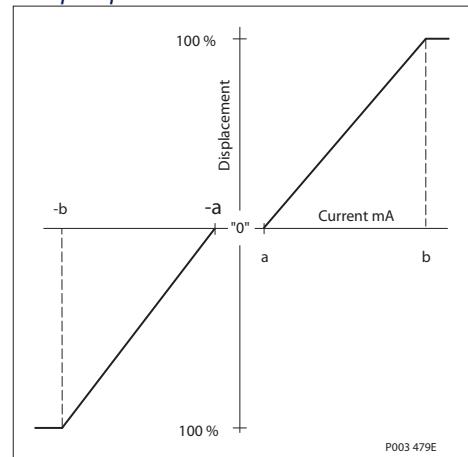


Charge pump power requirements



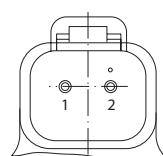
**Electrical Displacement Control (EDC),
Options 12 V and 24 V**
EDC principle

The Electrical Displacement Control (EDC) consists of a pair of proportional solenoids on each side of a three-position, four-way porting spool. The proportional solenoid applies a force input to the spool, which ports hydraulic pressure to either side of a double acting servo piston. Differential pressure across the servo piston rotates the swashplate, changing the pump's displacement from full displacement in one direction to full displacement in the opposite direction.

EDC

EDC-Schematic diagram

Pump displacement vs. control current

Control signal requirements
Control current

| Voltage | a* | b | Pin connections |
|---------|--------|---------|-----------------|
| 12 V | 650 mA | 1600 mA | any order |
| 24 V | 310 mA | 810 mA | |

* Factory test current, for vehicle movement or application actuation expect higher value.

Connector

Available connector models

| Description | Quantity |
|--|----------|
| Mating connector - Deutsch® DT06-2S | 1 |
| Wedge lock - Deutsch® W2S | 1 |
| Socket contact (16 and 18 AWG) - Deutsch® 0462-201-16141 | 2 |
| Sauer-Danfoss mating connector kit K29657 | 1 |

Series TM Transit Mixer Axial Piston Pump, Size 070/089

Technical Information

Technical Specifications

Electrical Displacement Control (EDC), Options 12 V and 24 V (continued)

Solenoid data

| Voltage | 12V | 24V |
|---|-----------|---------|
| Maximum current | 1800 mA | 920 mA |
| Coil resistance @ 20 °C [70 °F] | 3.66 Ω | 14.20 Ω |
| Coil resistance @ 80 °C [176 °F] | 4.52 Ω | 17.52 Ω |
| PWM Range | 70-200 Hz | |
| PWM Frequency (preferred)* | 100 Hz | |
| Inductance | 33 mH | 140 mH |
| IP Rating (IEC 60 529) + DIN 40 050, part 9 | IP 67 | |
| IP Rating (IEC 60 529) + DIN 40 050, part 9 with mating connector | | IP 69K |

* PWM signal required for optimum control performance.

Flow table

| Shaft rotation | CW | | CCW | |
|------------------------|-----|-----|-----|-----|
| | C1 | C2 | C1 | C2 |
| Port A | out | in | in | out |
| Port B | in | out | out | in |
| Servo port pressurized | M4 | M5 | M4 | M5 |

* For coil location see installation drawings.

Control response

TMP controls are available with optional control passage orifices to assist in matching the rate of swashplate response to the application requirements (e.g. in the event of electrical failure). Software ramp or rate limiting should be used to control vehicle response in normal operation. The time required for the pump output flow to change from zero to full flow (acceleration) or full flow to zero (deceleration) is a net function of spool porting, orifices, and charge pressure. A swashplate response table is available for each frame indicating available swashplate response times. Testing should be conducted to verify the proper software and orifice selection for the desired response.

TMP pumps are limited in mechanical orificing combinations. Software is envisioned as the means to control the swashplate response in normal operating conditions.
Mechanical servo orifices are to be used only for fail-safe return to neutral in the event of an electrical failure.

Typical response times shown below at the following conditions:

Δp = 200 bar [2900 psi]
 Viscosity and temperature = 30 mm²/s (50 °C) [141 SUS (122 °F)]
 Charge pressure = 20 bar [290 psi]
 Speed = 1800 min⁻¹ (rpm)

Response times

| Stroking direction | No orifice |
|----------------------|------------|
| Neutral to full flow | 1.2 s |
| Full flow to neutral | 0.6 s |

Technical Specifications

Manual Over Ride (MOR)

All controls are available with a Manual Over Ride (MOR) either standard or as an option for temporary actuation of the control to aid in diagnostics.

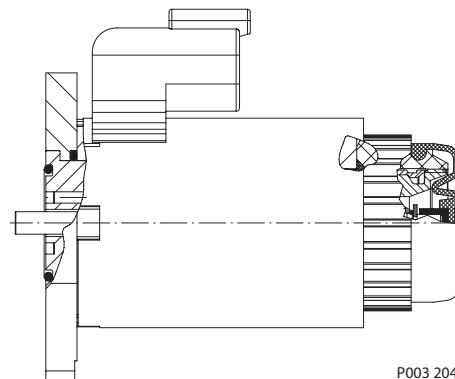
The vehicle or device must always be in a 'safe' condition (i.e. vehicle lifted off the ground) when using the MOR function. The MOR plunger has a 4 mm diameter and must be manually depressed to be engaged. Depressing the plunger mechanically moves the control spool which allows the pump to go on stroke. The MOR should be engaged anticipating a full stroke response from the pump.

⚠ Warning

A O-Ring seal is used to seal the MOR plunger where initial actuation of the function will require a force of 45 N to engage the plunger. Additional actuations typically require less force to engage the MOR plunger. Proportional control of the pump using the MOR should not be expected.

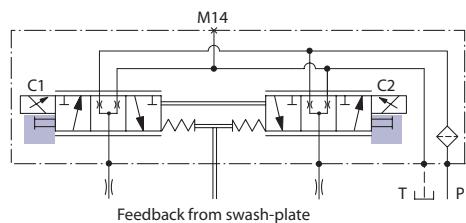
Refer to control flow table for the relationship of solenoid to direction of flow.

MOR



P003 204

MOR-Schematic diagram (EDC shown)



Speed Sensor Description

Function of the speed sensor is to detect the shaft speed and the direction of rotation. Typically the sensor will be mounted to the housing of a Sauer-Danfoss pump or motor and senses the speed from a target ring that is rotating inside the pump or motor. Because of the digital output signals for speed and direction and a non speed dependent output voltage level, the sensor is ideal for high and low speed measurements.

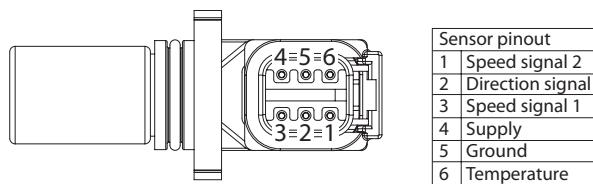
For diagnostics and other purposes, the sensor also has the capability to detect the case oil temperature.

The speed sensor is designed for rugged outdoor, mobile or heavy industrial speed sensing applications. The detection of the speed is contactless. It is custom-designed for Sauer-Danfoss. It is a "plug and perform" device that does not need any calibration or adjustments.

Connector model: DEUTSCH DTM-Series 6-Pin DTM06-6S (pins need to be gold plated)

Number of teeth on target ring: 53

Order number: 149055

Connector terminals

Bearing Life

Bearing life with no external shaft side load

Normal bearing life with no external shaft side load in L₂₀ hours is shown *in the table below*. The figures reflect a continuous delta pressure, shaft speed, maximum displacement, and no external shaft side load. The data is based on a standard charge pressure of 20 bar [290 psi].

Bearing life with no external shaft side load

| | Unit | Size 070 | Size 089 |
|--------------------------------------|-------------------------|------------|------------|
| Shaft speed | min ⁻¹ (rpm) | 1800 | 1800 |
| Delta pressure – Δp | bar [psi] | 240 [3480] | 240 [3480] |
| Bearing life – L₂₀ | hours | 68 900 | 28500 |

Conversion of bearing life for other pressure (p) and speed (n):

$$\text{Size 070 } L_{20} = 68\,900 \cdot \left(\frac{240}{p}\right)^{10/3} \cdot \left(\frac{1800}{n}\right)$$

$$\text{Size 089 } L_{20} = 28\,500 \cdot \left(\frac{240}{p}\right)^{10/3} \cdot \left(\frac{1800}{n}\right)$$

Bearing Life (continued)

External radial shaft loads

TM pumps are designed with bearings that can accept some external radial and axial loads.

The external radial shaft load limits are a function of the load position and orientation, and the operating conditions of the unit. The maximum allowable radial load (R_e) is based on the maximum external moment (M_e) and the distance (L) from the mounting flange to the load. In applications with external radial shaft loads, minimize the impact by positioning the load at 0° or 180° as shown *in the figure below*.

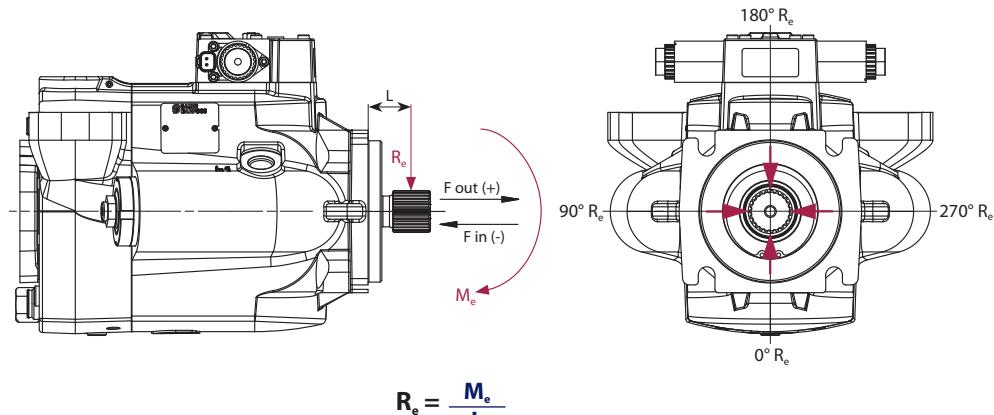
The external radial and axial shaft load are limited by the bearing life $L_{20} = 10\,000$ [h], delta system pressure 240 bar, speed 1800 min^{-1} and external radial load at 270° .

It may be determined using the following table and formula below.

Maximum external shaft load based on shaft deflection

| | Unit | Size 070 | Size 089 |
|--|--------------|--------------|--------------|
| External radial moment – M_e | N·m [lbf·in] | 0 | 70 [620] |
| External axial force – F_{in} | N [lbf] | -2160 [-485] | -1320 [-297] |
| External axial force – F_{out} | | 3660 [823] | 2880 [648] |

Radial load position



Where:

M_e = Shaft moment

L = Flange distance

R_e = External force to the shaft

Contact your Sauer-Danfoss representative for an evaluation of unit bearing life.

Mounting Flange Loads

Estimating overhung load moments

Based on SI units:

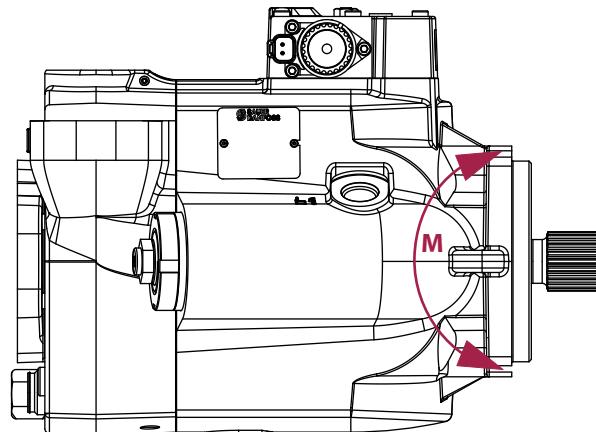
$$M = g \cdot G \cdot W \cdot L$$

Based on US units:

$$M = G \cdot W \cdot L$$

Where:

| | | |
|----------|---|-----------------------|
| M | = Rated load moment | N·m [lbf·in] |
| g | = Gravity | 9.81 m/s ² |
| G | = Calculation factor for max. acceleration | 30 |
| W | = Weight of pump | kg [lb] |
| L | = Distance from mounting flange to pump center of gravity | m [in] |



Rated and maximum torque ratings

| W kg [lb] | L m [in] | Max. load moment M N·m [lbf·in] |
|---------------------|--------------------|---|
| 61 [134] | 0,1625 [6,398] | 2917 [25 818] |

Input Shafts

Rated and maximum torque ratings for each available shaft is shown in the following table:

Specifications

| Spline | Min active spline length | | Rated torque* | | Maximum torque** | |
|-----------------------|--------------------------|-------|---------------|----------|------------------|----------|
| | mm | [in] | N·m | [lbf·in] | N·m | [lbf·in] |
| 21 teeth, 16/32 pitch | 33 | [1.3] | 730 | [6460] | 1200 | [10 620] |
| 23 teeth, 16/32 pitch | 33 | [1.3] | 880 | [7790] | 1600 | [14 160] |
| Cardan / flange | - | | - | | 2480 | [21 950] |

* Rated torque - measure of teeth wear

** Maximum torque - ratings are based on torsional fatigue strength

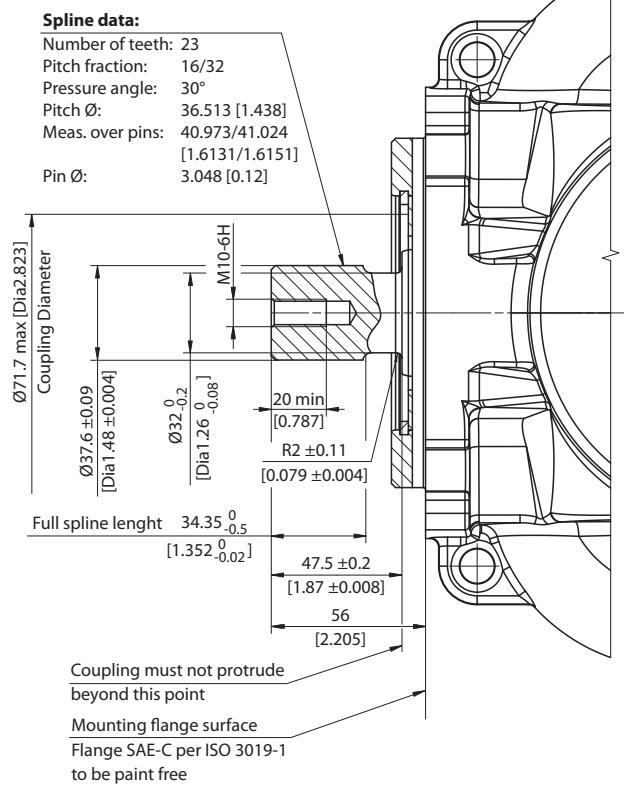
The specified torque rating of the shaft documented above is based on the cross-sectional diameter of the shaft, through the keyway, and assumes the proper clamp and fit between shaft and coupling. Sauer-Danfoss guarantees the design and manufactured quality of the splined shaft. The customer is responsible for the design and manufactured quality of the mating female coupling and key and applied torque on the nut.

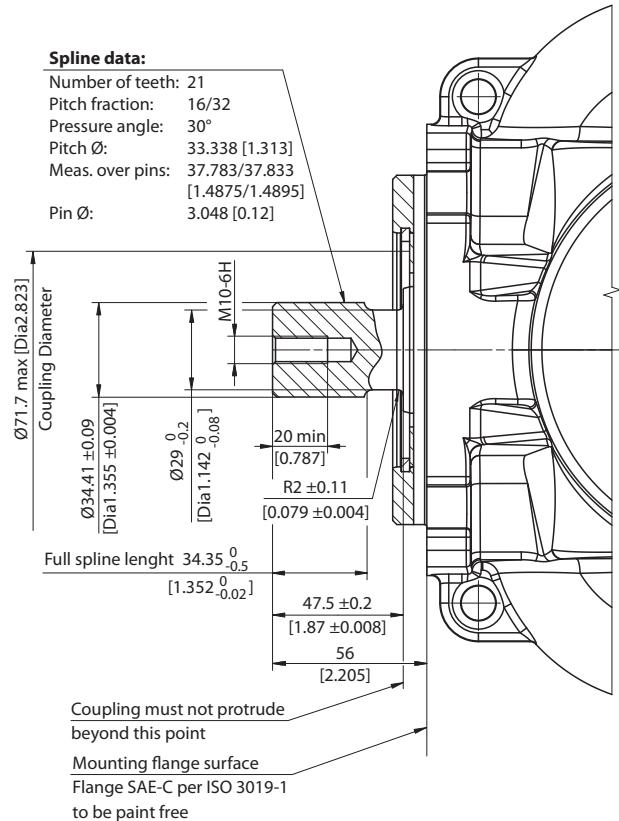
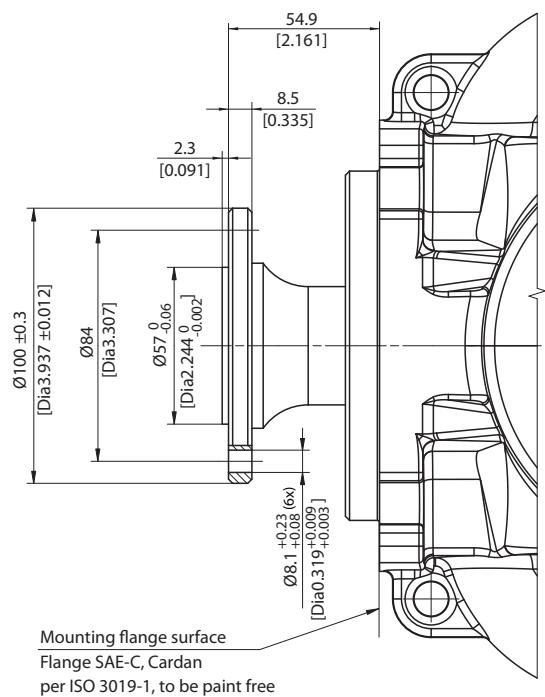
Sauer-Danfoss has made provisions for the key in accordance to the ISO specification with the understanding that the key is solely to assist in the installation of the mating coupling.

Caution

Torque or loading inadvertently transmitted by the customer supplied key may lead to premature shaft failure.

ISO 3019-1 (SAE C, 23-teeth)

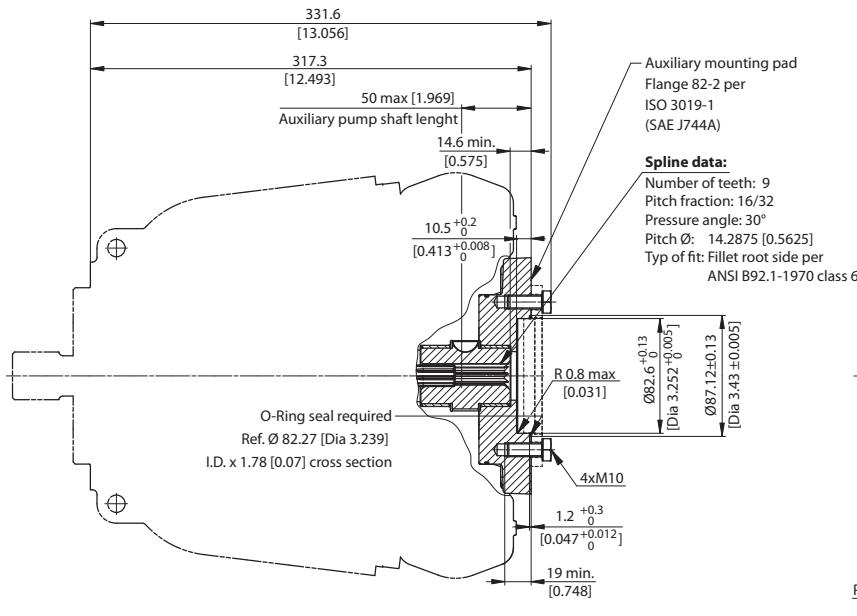


Input Shafts (continued)
ISO 3019-1 (SAE C, 21-teeth)

ISO 3019-1 (SAE C, Cardan)


There is another possible option 23-teeth with coupling, see the section *Dimensions*, pages 28 - 29

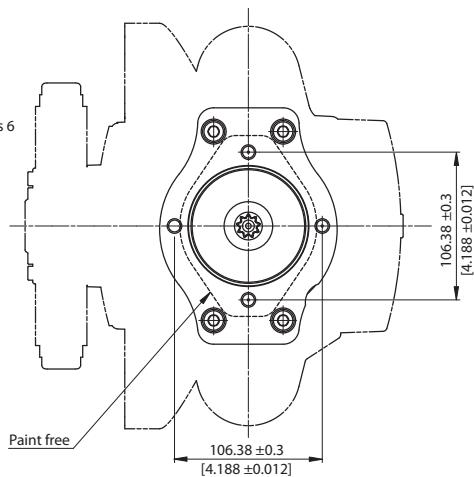
Auxiliary Mounting Pads

ISO 3019-1, flange 82-2 (SAE A, 9-teeth)



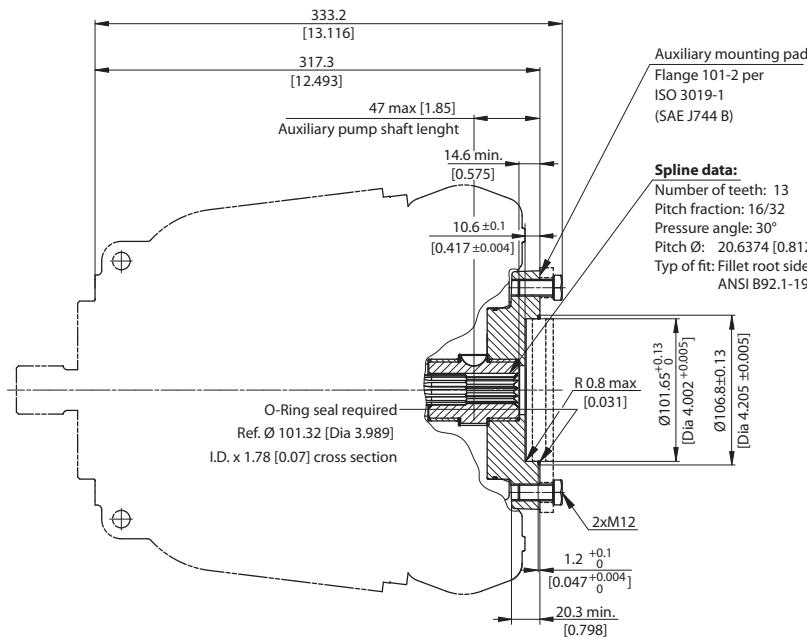
Specifications

| Spline | Maximum torque | |
|----------------------|----------------|----------|
| | N·m | [lbf·in] |
| 9-teeth, 16/32 pitch | 162 | [1430] |

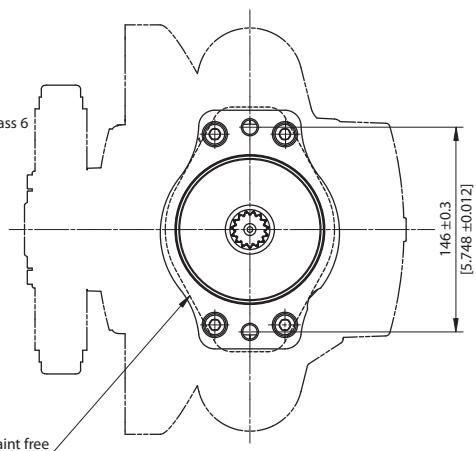


Caution

Standard pad cover is installed only to retain coupling during shipping. Do not operate pump without an auxiliary pump or running cover installed.

Auxiliary Mounting Pads (continued)
ISO 3019-1, Flange 101-2 (SAE B, 13-teeth)

Specifications

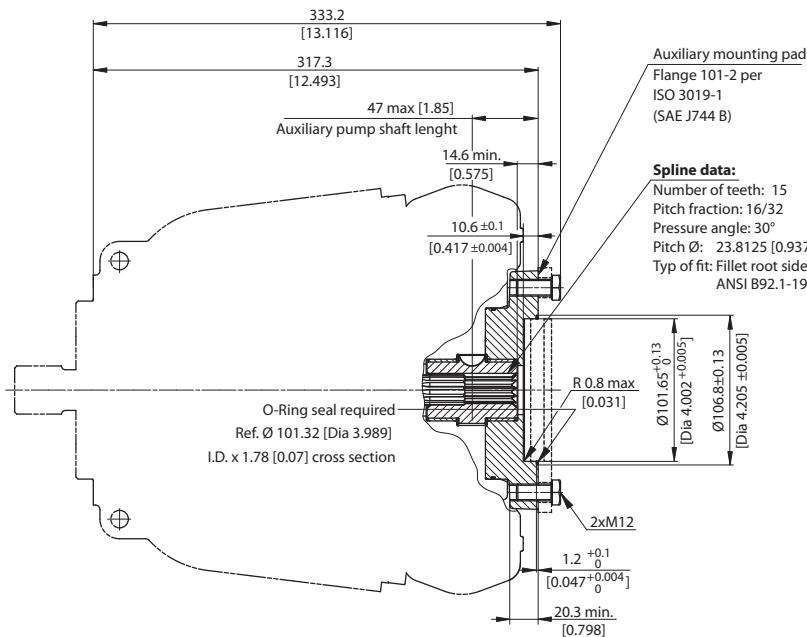
| Spline | Maximum torque | |
|-----------------------|----------------|----------|
| | N·m | [lbf·in] |
| 13-teeth, 16/32 pitch | 395 | [3500] |


Caution

Standard pad cover is installed only to retain coupling during shipping. Do not operate pump without an auxiliary pump or running cover installed.

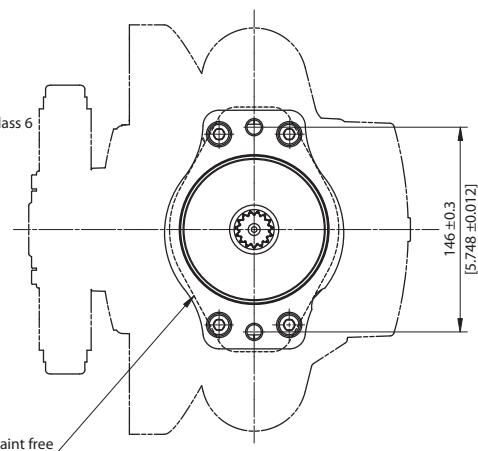
Auxiliary Mounting Pads (continued)

ISO 3019-1, Flange 101-2 (SAE B-B, 15-teeth)



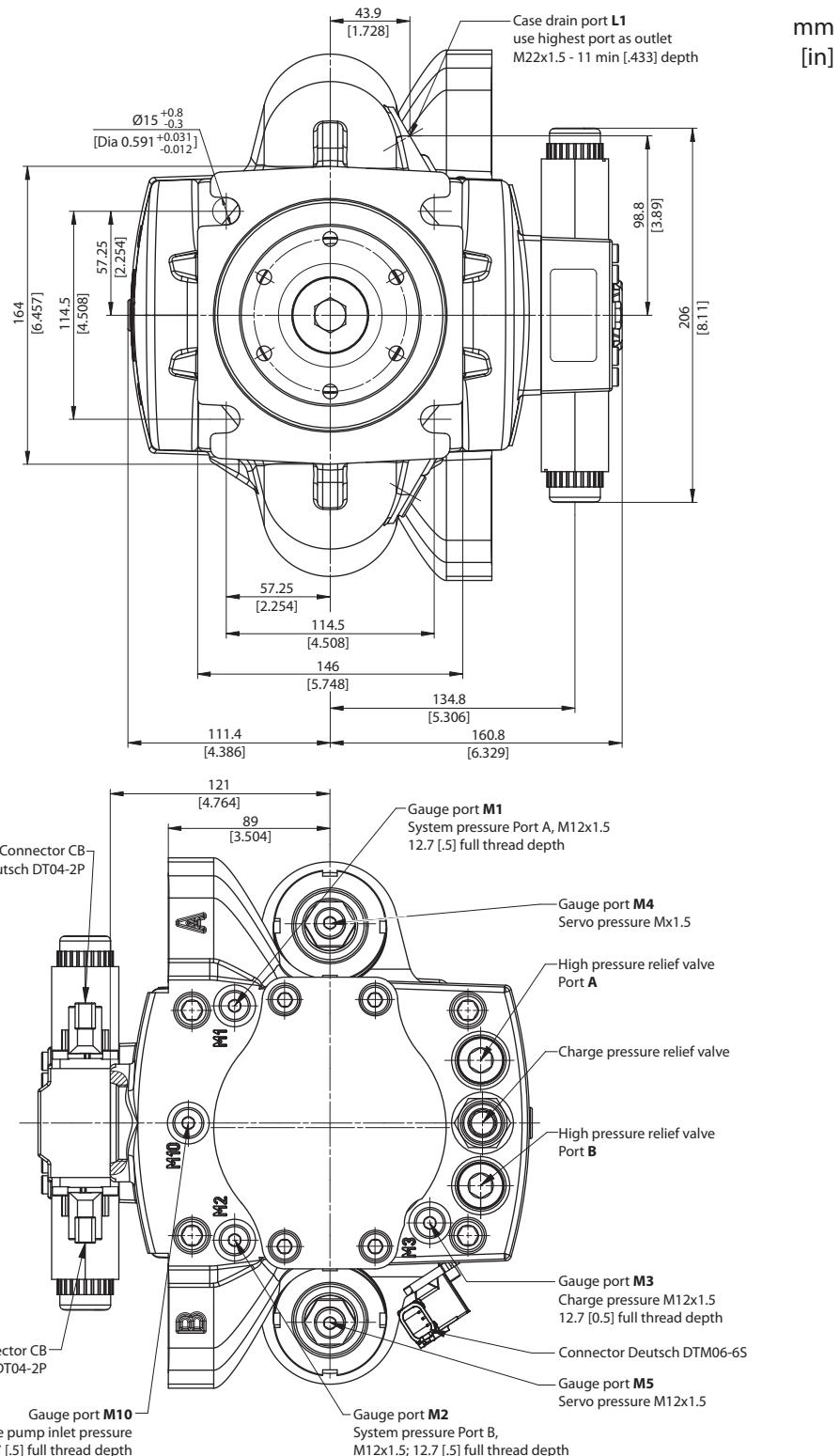
Specifications

| Spline | Maximum torque | |
|-----------------------|----------------|----------|
| | N·m | [lbf·in] |
| 15-teeth, 16/32 pitch | 693 | [6130] |

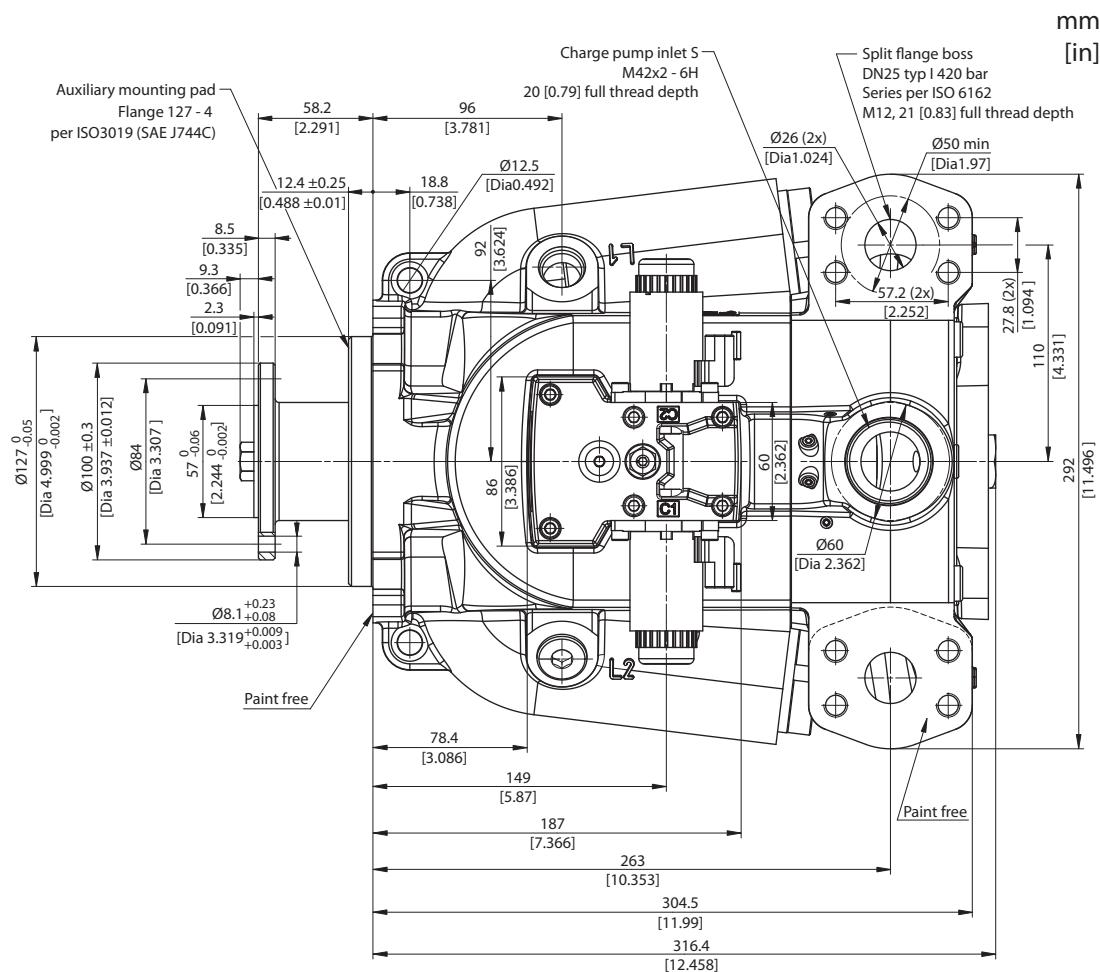


Caution

Standard pad cover is installed only to retain coupling during shipping. Do not operate pump without an auxiliary pump or running cover installed.

Dimensions


**Dimensions
 (continued)**



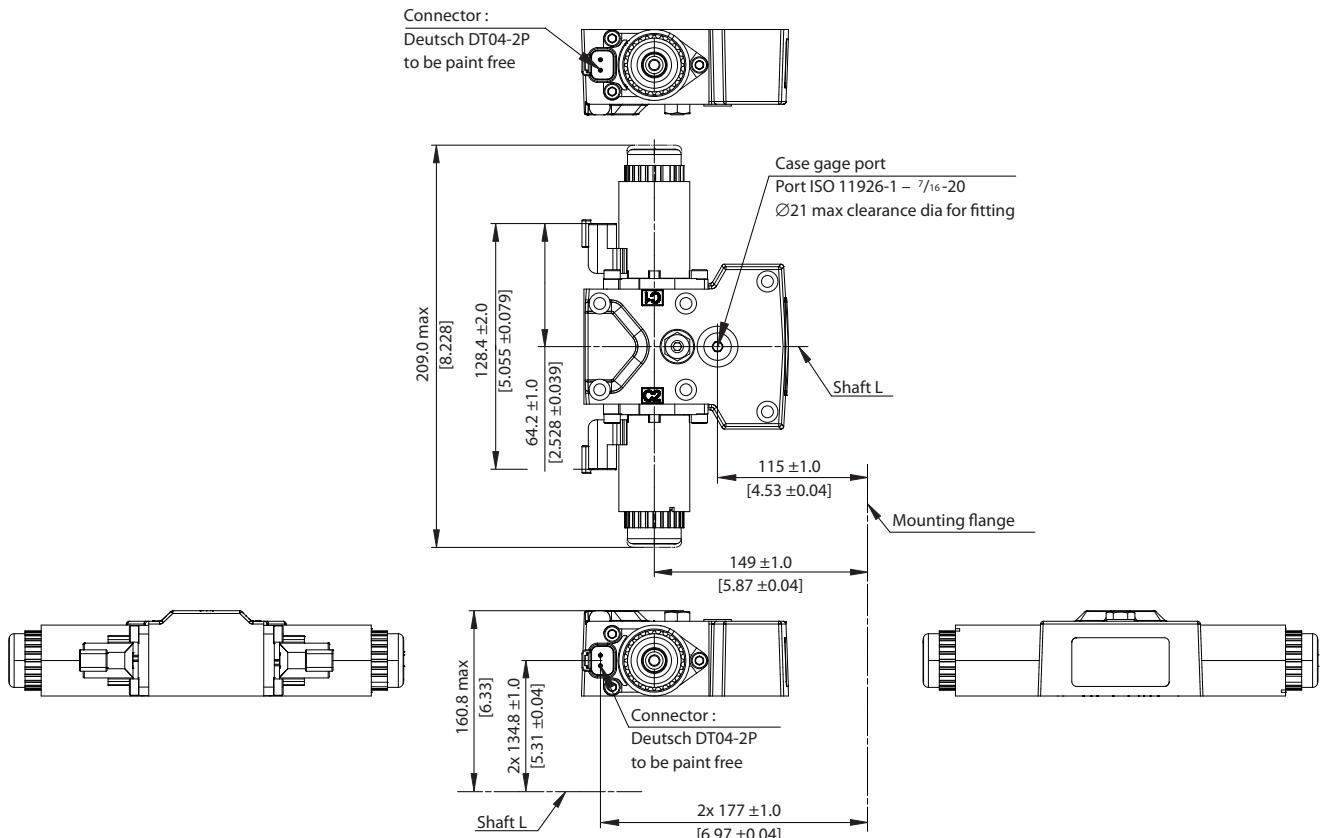
Port description

| Port | Description | Sizes |
|------------|-----------------------------------|---------|
| A | System port "A" | Ø 25.4 |
| B | System port "B" | Ø 25.4 |
| L1 | Case drain port | M22x1.5 |
| L2 | Case drain port | M22x1.5 |
| M1 | System A gage port | M12x1.5 |
| M2 | System B gage port | M12x1.5 |
| M3 | Charge gage port, after filtering | M12x1.5 |
| M4 | Servo gage port | M12x1.5 |
| M5 | Servo gage port | M12x1.5 |
| M10 | Charge pump inlet pressure | M12x1.5 |
| S | Charge inlet port | M42x2 |

Please contact Sauer-Danfoss for specific installation drawings.

Control Dimensions

Electric Displacement Control (EDC) with manual override, options 12 V and 24 V





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