

Technical Information

Hydraulic Brakes and Accessories



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OPERATING RECOMMENDATIONS

OIL TYPE

Hydraulic oils with anti-wear, anti-foam and demulsifiers are recommended for systems incorporating Impro Fluidtek brakes. Straight oils can be used but may require VI (viscosity index improvers depending on the operating temperature range of the system. Other water based and environmentally friendly oils may be used, but service life of the brake and other components in the system may be significantly shortened. Before using any type of fluid, consult the fluid requirements for all components in the system for compatibility. Testing under actual operating conditions is the only way to determine if acceptable service life will be achieved.

FLUID VISCOSITY & FILTRATION

Fluids with a viscosity between 20 - 43 cSt [100 - 200S.U.S.] at operating temperature is recommended. Fluid temperature should also be maintained below 85°C [180°F]. It is also suggested that the type of pump and its operating specifications be taken into account when choosing a fluid for the system. Fluids with high viscosity can cause cavitation at the inlet side of the pump. Systems that operate over a wide range of temperatures may require viscosity improvers to provide acceptable fluid performance. Impro Fluidtek recommends maintaining an oil cleanliness level of ISO 17-14 or better.

INSTALLATION & START-UP

When installing an Impro Fluidtek brake it is important that the mounting flange of the brake makes full contact with the mounting surface of the application. Mounting hardware of the appropriate grade and size must be used. Hubs, pulleys, sprockets and couplings must be properly aligned to avoid inducing excessive thrust or radial loads. Although the output device must fit the shaft snug, a hammer should never be used to install any type of output device onto the shaft. The port plugs should only be removed from the brake when the system connections are ready to be made. To avoid contamination, remove all matter from around the ports of the brake and the threads of the fittings.

HYDRAULIC BRAKE PRECAUTION

Caution! - Impro Fluidtek brakes are intended to operate as static or parking brakes. System circuitry must be designed to bring the load to a stop before applying the brake.

To achieve proper brake release operation, it is necessary to bleed out any trapped air and fill brake release cavity and hoses before all connections are tightened. To facilitate this operation, all brakes feature two release ports. One or both of these ports may be used to release the brake in the unit. Brakes should be configured so that the release ports are near the top of the unit in the installed position.

Once all system connections are made, one release port must be opened to atmosphere and the brake release line carefully charged with fluid until all air is removed from the line and brake release cavity. When this has been accomplished the port plug or secondary release line must be reinstalled. In the event of a pump or battery failure, an external pressure source may be connected to the brake release port to release the brake, allowing the machine to be moved.

ALLOWABLE BEARING & SHAFT LOADING

This catalog provides curves showing allowable radial loads at points along the longitudinal axis of the brake. They are dimensioned from the mounting flange. Two capacity curves for the shaft and bearings are shown. A vertical line through the centerline of the load drawn to intersect the x-axis intersects the curves at the load capacity of the shaft and of the bearing.

In the example below the maximum radial load bearing rating is between the internal roller bearings illustrated with a solid line. The allowable shaft rating is shown with a dotted line.

The bearing curves for each model are based on laboratory analysis and testing results constructed at Impro Fluidtek. The shaft loading is based on a 3:1 safety factor and 330 Kpsi tensile strength. The allowable load is the lower of the curves at a given point. For instance, one inch in front of the mounting flange the bearing capacity is lower than the shaft capacity. In this case, the bearing is the limiting load. The brake user needs to determine which series of brake to use based on their application knowledge.

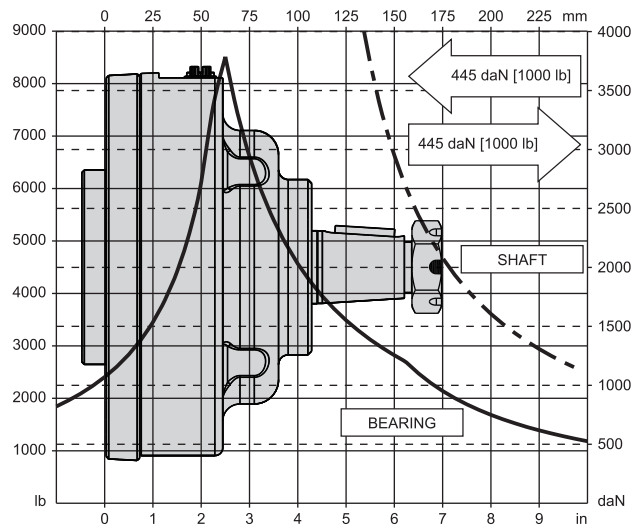
ISO 281 RATINGS VS. MANUFACTURERS RATINGS

Published bearing curves can come from more than one type of analysis. The ISO 281 bearing rating is an international standard for the dynamic load rating of roller bearings. The rating is for a set load at a speed of 33 1/3 RPM for 500 hours (1 million revolutions). The standard was established to allow consistent comparisons of similar bearings between manufacturers. The ISO 281 bearing ratings are based solely on the physical characteristics of the bearings, removing any manufacturers specific safety factors or empirical data that influences the ratings.

Manufacturers' ratings are adjusted by diverse and systematic laboratory investigations, checked constantly with feedback from practical experience. Factors taken into account that affect bearing life are material, lubrication, cleanliness of the lubrication, speed, temperature, magnitude of the load and the bearing type.

The operating life of a bearing is the actual life achieved by the bearing and can be significantly different from the calculated life. Comparison with similar applications is the most accurate method for bearing life estimations.

SIDE LOAD CHART



EXAMPLE LOAD RATING FOR MECHANICALLY RETAINED NEEDLE ROLLER BEARINGS

$$\text{Bearing Life } L_{10} = (C/P)^p [10^6 \text{ revolutions}]$$

L_{10} = nominal rating life

C = dynamic load rating

P = equivalent dynamic load

Life Exponent p = 10/3 for needle bearings

BEARING LOAD MULTIPLICATION FACTOR TABLE			
RPM	FACTOR	RPM	FACTOR
50	1.23	500	0.62
100	1.00	600	0.58
200	0.81	700	0.56
300	0.72	800	0.50
400	0.66		

VEHICLE DRIVE CALCULATIONS

When selecting a wheel drive motor for a mobile vehicle, a number of factors concerning the vehicle must be taken into consideration to determine the required maximum motor RPM, the maximum torque required and the maximum load each motor must support. The following sections contain the necessary equations to determine this criteria. An example is provided to illustrate the process.

Sample application (vehicle design criteria)

Vehicle description..... 4 wheel vehicle
GVW1,500 lbs.
Rolling radius of tires16 in.
Top speed..... 5 mph
Worst working surface..... poor asphalt

Vehicle drive.2 wheel drive
Weight over each drive wheel 425 lbs.
Desired acceleration 0-5 mph in 10 sec.
Gradability..... 20%

To determine maximum motor speed

$$\text{RPM} = \frac{2.65 \times \text{KPH} \times G}{r_m} \quad \text{RPM} = \frac{168 \times \text{MPH} \times G}{r_i}$$

Where:

MPH = Max. vehicle speed (miles/hr)

KPH = Max. vehicle speed (kilometers/hr)

r_i = Rolling radius of tire (inches)

G = Gear reduction ratio (if none, G = 1)

r_m = Rolling radius of tire (meters)

Example $\text{RPM} = \frac{168 \times 5 \times 1}{16} = 52.5$

To determine maximum torque requirement of motor

To choose a motor(s) capable of producing enough torque to propel the vehicle, it is necessary to determine the Total Tractive Effort (TE) requirement for the vehicle.

To determine the total tractive effort, the following equation must be used:

$$\text{TE} = \text{RR} + \text{GR} + \text{FA} + \text{DP} \text{ (lbs or N)}$$

Where:

TE = Total tractive effort

RR = Force necessary to overcome rolling resistance

GR = Force required to climb a grade

FA = Force required to accelerate

DP = Drawbar pull required

The components for this equation may be determined using the following steps:

► Step One: Determine Rolling Resistance

Rolling Resistance (RR) is the force necessary to propel a vehicle over a particular surface. It is recommended that the worst possible surface type to be encountered by the vehicle be factored into the equation.

$$\text{RR} = \frac{\text{GVW}}{1000} \times R \text{ (lb or N)}$$

Where:

GVW = Gross (loaded) vehicle weight (lb or kg)

R = Surface friction (value from Rolling Resistance)

Example $\text{RR} = \frac{1500}{1000} \times 22 \text{ lbs} = 33 \text{ lbs}$

Rolling Resistance

Concrete (excellent).....10	Cobbles (ordinary)55
Concrete (good).....15	Cobbles (poor)37
Concrete (poor)20	Snow (2 inch).....25
Asphalt (good)12	Snow (4 inch).....37
Asphalt (fair)17	Dirt (smooth).....25
Asphalt (poor).....22	Dirt (sandy)37
Macadam (good).....15	Mud.....37 to 150
Macadam (fair)22	Sand (soft).....60 to 150
Macadam (poor)37	Sand (dune).....160 to 300

► Step Two: Determine Grade Resistance

Grade Resistance (GR) is the amount of force necessary to move a vehicle up a hill or “grade.” This calculation must be made using the maximum grade the vehicle will be expected to climb in normal operation.

To convert incline degrees to % Grade:

$$\% \text{ Grade} = [\tan \text{ of angle (degrees)}] \times 100$$

$$\text{GR} = \frac{\% \text{ Grade}}{100} \times \text{GVW (lb or N)}$$

Example
$$\text{RR} = \frac{20}{100} \times 1500 \text{ lbs} = 300 \text{ lbs}$$

► Step Three: Determine Acceleration Force

Acceleration Force (FA) is the force necessary to accelerate from a stop to maximum speed in a desired time.

$$\text{FA} = \frac{\text{MPH} \times \text{GVW (lb)}}{22 \times t} \quad \text{FA} = \frac{\text{KPH} \times \text{GVW (N)}}{35.32 \times t}$$

Where:

t = Time to maximum speed (seconds)

Example
$$\text{FA} = \frac{5 \times 1500 \text{ lbs}}{22 \times 10} = 34 \text{ lbs}$$

► Step Four: Determine Drawbar Pull

Drawbar Pull (DP) is the additional force, if any, the vehicle will be required to generate if it is to be used to tow other equipment. If additional towing capacity is required for the equipment, repeat steps one through three for the towable equipment and sum the totals to determine DP.

► Step Five: Determine Total Tractive Effort

The Tractive Effort (TE) is the sum of the forces calculated in steps one through three above. On low speed vehicles, wind resistance can typically be neglected. However, friction in drive components may warrant the addition of 10% to the total tractive effort to insure acceptable vehicle performance.

$$\text{TE} = \text{RR} + \text{GR} + \text{FA} + \text{DP (lb or N)}$$

Example
$$\text{TE} = 33 + 300 + 34 + 0 \text{ (lbs)} = 367 \text{ lbs}$$

► Step Six: Determine Motor Torque

The Motor Torque (T) required per motor is the Total Tractive Effort divided by the number of motors used on the machine. Gear reduction is also factored into account in this equation.

$$T = \frac{\text{TE} \times r_i}{M \times G} \text{ lb-in per motor} \quad T = \frac{\text{TE} \times r_m}{M \times G} \text{ Nm per motor}$$

Where:

M = Number of driving motors

Example
$$T = \frac{367 \times 16}{2 \times 1} \text{ lb-in / motor} = 2936 \text{ lb-in}$$

► Step Seven: Determine Wheel Slip

To verify that the vehicle will perform as designed in regards to tractive effort and acceleration, it is necessary to calculate wheel slip (TS) for the vehicle. In special cases, wheel slip may actually be desirable to prevent hydraulic system overheating and component breakage should the vehicle become stalled.

$$TS = \frac{W \times f \times r_i}{G} \quad TS = \frac{W \times f \times r_m}{G}$$

(lb-in per motor) (Nm per motor)

Where:

f = Coefficient of friction

W = Loaded vehicle weight over driven wheel (lb or N)

Example $TS = \frac{425 \times .06 \times 16}{1} \text{ lb-in / motor} = 4080 \text{ lbs}$

Coefficient of friction (f)

Steel on steel.....	0.3
Rubber tire on dirt	0.5
Rubber tire on a hard surface.....	0.6 - 0.8
Rubber tire on cement	0.7

To determine radial load capacity requirement of motor

When a motor used to drive a vehicle has the wheel or hub attached directly to the motor shaft, it is critical that the radial load capabilities of the motor are sufficient to support the vehicle. After calculating the Total Radial Load (RL) acting on the motors, the result must be compared to the bearing/shaft load charts for the chosen motor to determine if the motor will provide acceptable load capacity and life.

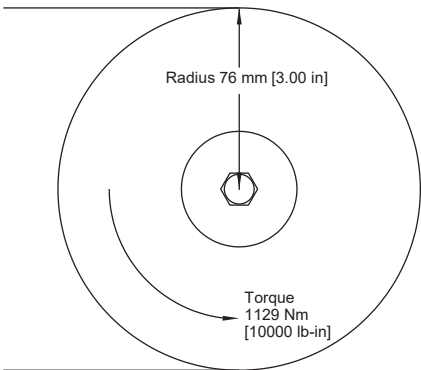
$$RL = \sqrt{W^2 + \left(\frac{T}{r_i}\right)^2} \text{ lb} \quad RL = \sqrt{W^2 + \left(\frac{T}{r_m}\right)^2} \text{ kg}$$

Example $RL = \sqrt{425^2 + \left(\frac{2936}{16}\right)^2} = 463 \text{ lbs}$

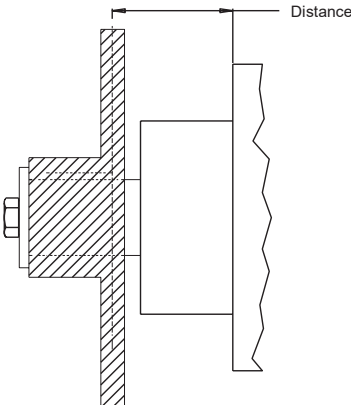
Once the maximum motor RPM, maximum torque requirement, and the maximum load each motor must support have been determined, these figures may then be compared to the motor performance charts and to the bearing load curves to choose a series and displacement to fulfill the motor requirements for the application.

INDUCED SIDE LOAD

In many cases, pulleys or sprockets may be used to transmit the torque produced by the motor. Use of these components will create a torque induced side load on the motor shaft and bearings. It is important that this load be taken into consideration when choosing a motor with sufficient bearing and shaft capacity for the application.



To determine the side load, the brake torque and pulley or sprocket radius must be known. Side load may be calculated using the formula below. The distance from the pulley/sprocket centerline to the mounting flange of the brake must also be determined. These two figures may then be compared to the bearing and shaft load curve of the desired brake to determine if the side load falls within acceptable load ranges.



Side Load = $\frac{\text{Torque}}{\text{Radius}}$
Side Load = 14855 N [3333 lbs]

HYDRAULIC EQUATIONS

Multiplication Factor	Abbrev.	Prefix
10 ¹²	T	tera
10 ⁹	G	giga
10 ⁶	M	mega
10 ³	K	kilo
10 ²	h	hecto
10 ¹	da	deka
10 ⁻¹	d	deci
10 ⁻²	c	centi
10 ⁻³	m	milli
10 ⁻⁶	u	micro
10 ⁻⁹	n	nano
10 ⁻¹²	p	pico
10 ⁻¹⁵	f	femto
10 ⁻¹⁸	a	atto

Theo. Speed (RPM) = $\frac{1000 \times \text{LPM}}{\text{Displacement (cm}^3\text{/rev)}}$ or $\frac{231 \times \text{GPM}}{\text{Displacement (in}^3\text{/rev)}}$

Theo. Torque (lb-in) = $\frac{\text{Bar} \times \text{Disp. (cm}^3\text{/rev)}}{20 \text{ pi}}$ or $\frac{\text{PSI} \times \text{Displacement (in}^3\text{/rev)}}{6.28}$

Power In (HP) = $\frac{\text{Bar} \times \text{LPM}}{600}$ or $\frac{\text{PSI} \times \text{GPM}}{1714}$

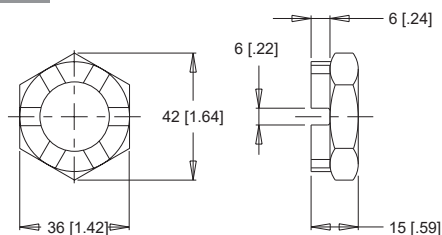
Power Out (HP) = $\frac{\text{Torque (Nm)} \times \text{RPM}}{9543}$ or $\frac{\text{Torque (lb-in)} \times \text{RPM}}{63024}$

SHAFT NUT INFORMATION

35MM TAPERED SHAFTS

M24 x 1.5 Thread

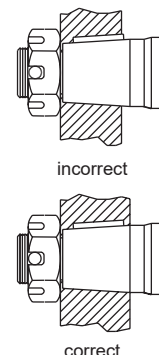
A Slotted Nut



Torque Specifications: 32.5 daNm [240 ft.lb.]

PRECAUTION

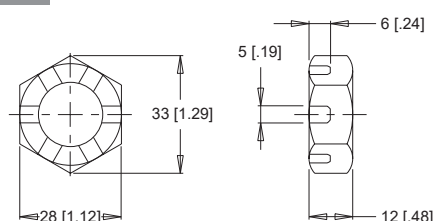
The tightening torques listed with each nut should only be used as a guideline. Hubs may require higher or lower tightening torque depending on the material. Consult the hub manufacturer to obtain recommended tightening torque. To maximize torque transfer from the shaft to the hub, and to minimize the potential for shaft breakage, a hub with sufficient thickness must fully engage the taper length of the shaft.



1" TAPERED SHAFTS

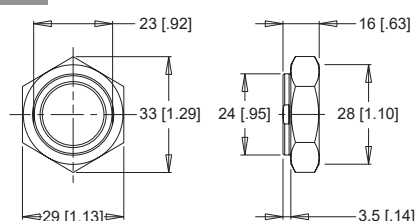
3/4-28 Thread

A Slotted Nut



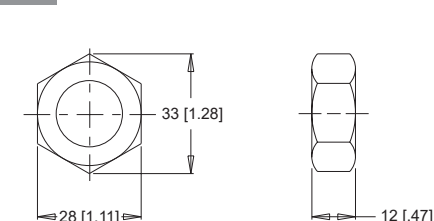
Torque Specifications: 20 - 23 daNm [150 - 170 ft.lb.]

B Lock Nut



Torque Specifications: 24 - 27 daNm [180 - 200 ft.lb.]

C Solid Nut

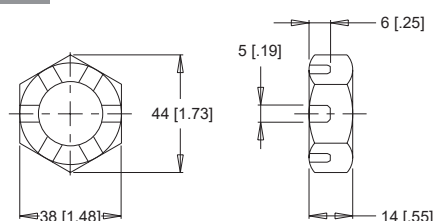


Torque Specifications: 20 - 23 daNm [150 - 170 ft.lb.]

1-1/4" TAPERED SHAFTS

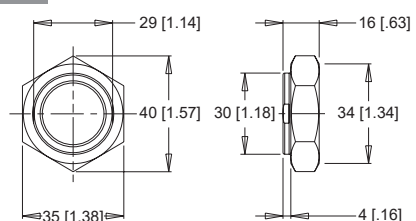
1-20 Thread

A Slotted Nut



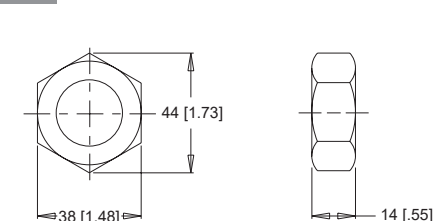
Torque Specifications: 38 daNm [280 ft.lb.] Max.

B Lock Nut



Torque Specifications: 33 - 42 daNm [240 - 310 ft.lb.]

C Solid Nut

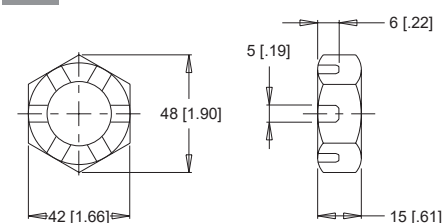


Torque Specifications: 38 daNm [280 ft.lb.] Max.

1-3/8" & 1-1/2" TAPERED SHAFTS

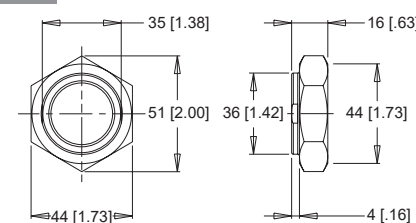
1 1/8-18 Thread

A Slotted Nut



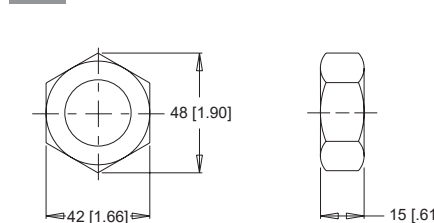
Torque Specifications: 41 - 54 daNm [300 - 400 ft.lb.]

B Lock Nut



Torque Specifications: 34 - 48 daNm [250 - 350 ft.lb.]

C Solid Nut



Torque Specifications: 41 - 54 daNm [300 - 400 ft.lb.]

OVERVIEW

The ABR series brake is a normally closed, dry type, spring-applied, hydraulically released brake and provides up to 1130 Nm (10,000 lb-in) holding torque for static brake applications. Critical components as roller bearings, springs, seals and the brake disks are dimensioned and chosen for maximum durability. All internal components are running in an oil bath to extend the service life and to reduce the noise. The combination of RE 550 series motor, ABR series hydraulic brake and HRP series release pump is the best solution for braking of motion drive of aerial work platform.

FEATURES / BENEFITS

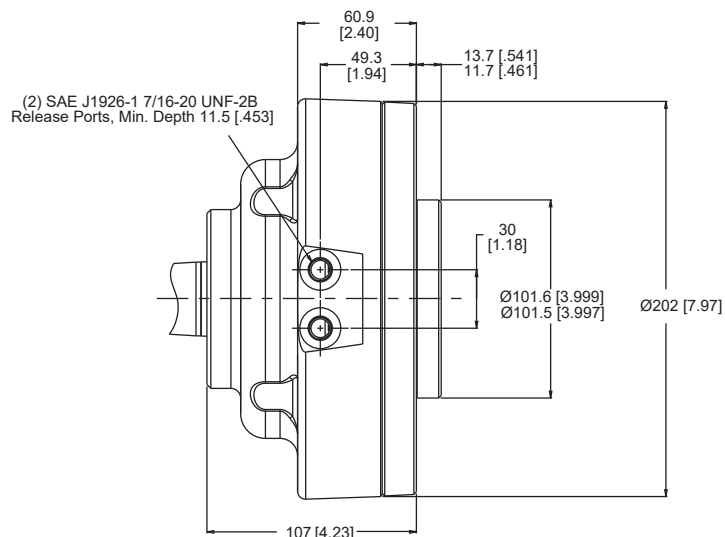
- High strength and wear resistance friction plate run in an oil bath.
- Smooth, quiet and robust braking performance, long service life.
- Integrated roller bearings support high side loads.

TYPICAL APPLICATIONS

Wheel drives, positioners, conveyors, door openers, swing drives, aerial work platforms and more.

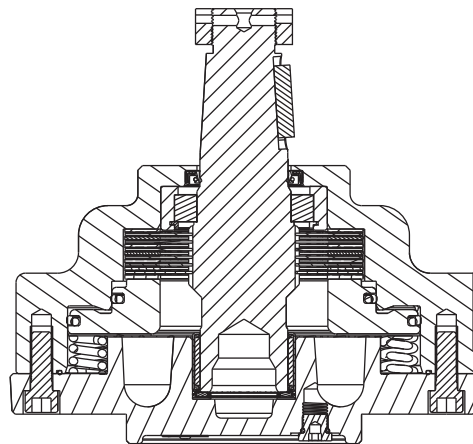
HOUSINGS

4-HOLE, BRAKE MOUNT, ALIGNED PORTS

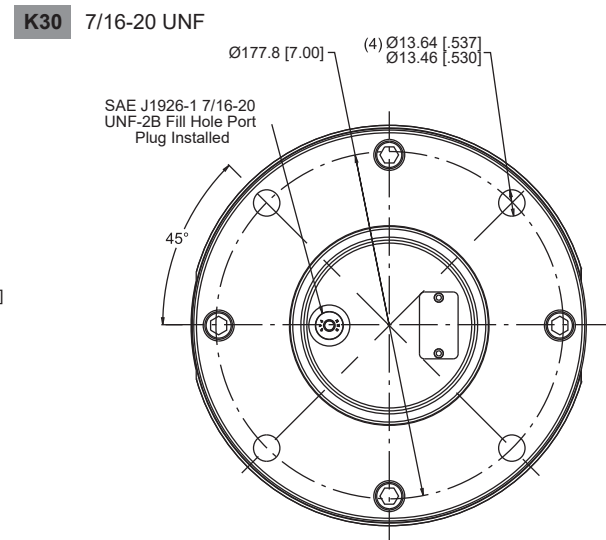


SPECIFICATIONS

ABR Series Holding Torque	1130 Nm [10,000 lb-in]
Release Pressure	28 bar [406 psi]
Maximum Release Pressure	207 bar [3,000 psi]
Release Volume	11.5 cm ³ [0.7 in ³]
Max. Speed	250 rpm
Max. Operating Temperature	82°C [180°F]
Weight	15.8 kg [35 lb]
Fluid Type	Mineral based oil



► Dimensions shown are without paint. Paint thickness can be up to 0.13 [0.005].

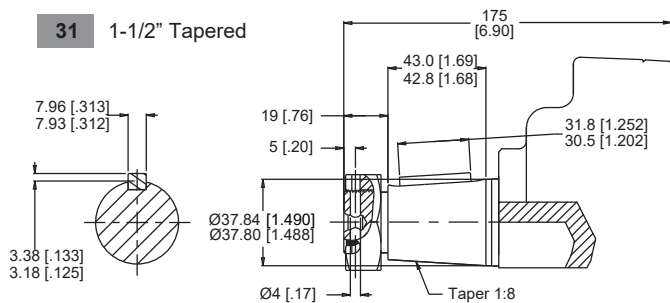


TECHNICAL INFORMATION

ALLOWABLE SHAFT LOAD / BEARING CURVE

The bearing curve represents allowable bearing loads based on ISO 281 bearing capacity for an L_{10} life of 2,000 hours at 100 rpm. Radial loads for speeds other than 100 rpm may be calculated using the multiplication factor table on page 5.

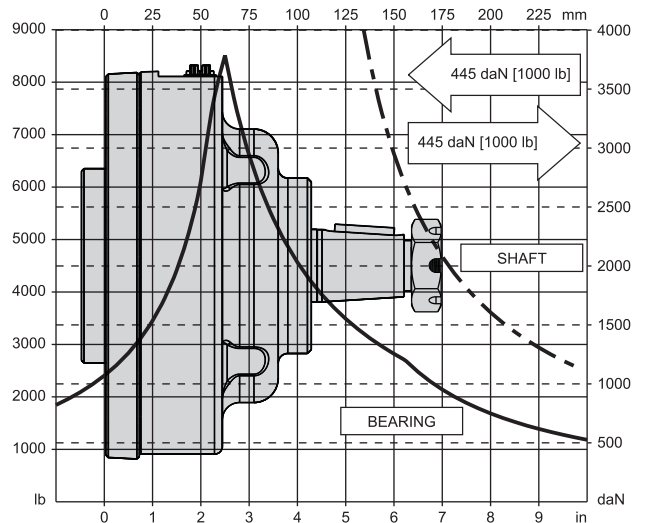
SHAFTS



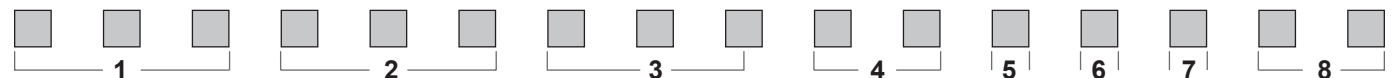
Max. Torque: 2700 Nm [19900 lb-in]

► A slotted hex nut is standard on this shaft. Dimensional details & additional options are listed on page 10.

ABR SERIES BRAKE - SIDE LOAD CHART



ORDERING INFORMATION



1. CHOOSE SERIES DESIGNATION

ABR Hydraulic Brake

2. SELECT A HOLDING TORQUE OPTION

1K1 Standard

3. SELECT A MOUNT & PORT OPTION

K30 4-Hole, Brake Mount, Aligned Ports, 7/16-20 UNF

4. SELECT A SHAFT OPTION

31 1-1/2" Tapered

5. SELECT A PAINT OPTION

A Black
Z No Paint

6. SELECT A VALVE CAVITY / CARTRIDGE OPTION

A None

7. SELECT AN ADD-ON OPTION

A Standard
C Solid Hex Nut

8. SELECT A MISCELLANEOUS OPTION

AA None

► For options not listed in the table above, please contact us with your requirements.

OVERVIEW

The AAB series features a multi-wet disc brake designed for exceptional performance. Its internal components are fully submerged in pre-filled fluid and are environmentally sealed, ensuring protection against contamination and corrosion, which enhances brake durability and maintains optimal holding capacity. With a compact design that offers high holding torque, reduced release pressure, and lower free turn torque, this brake system saves space.

SPECIFICATIONS

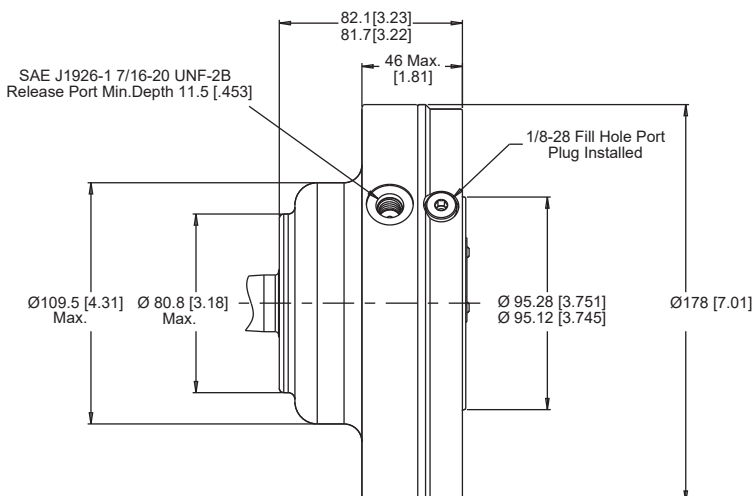
Holding Torque	475 Nm [4,200 lb-in]
Release Pressure	20 bar [290 psi]
Maximum Release Pressure	207 bar [3,000 psi]
Release Volume	9.0 cm ³ [0.55 in ³]
Max. Speed	250 rpm
Max. Operating Temperature	82°C [180°F]
Weight	9.25 kg [20.4 lb]
Fluid Type	Mineral based oil

TYPICAL APPLICATIONS

Wheel drives, positioners, conveyors, door openers, swing drives, aerial work platforms and more.

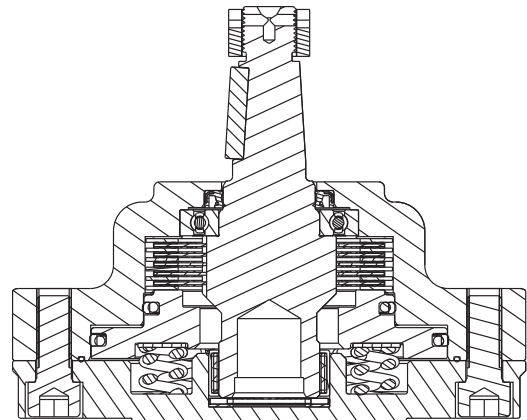
HOUSINGS

4-HOLE, BRAKE MOUNT



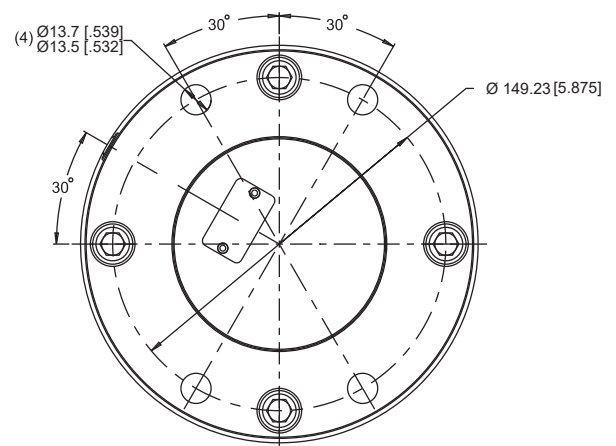
FEATURES / BENEFITS

- Space efficient design.
- Advanced friction materials for a round brake performance.
- Ball bearings handle greater shaft loads and extend the lifespan of shaft seals.
- An oil-filled cavity immerses all components, ensuring quiet operation.
- High-holding torque with reduced release pressure and free-turn torque.
- Spring-applied hydraulic release operation guarantees safety.
- Once installed, the brakes are completely sealed and capable of withstanding a range of challenging environments.



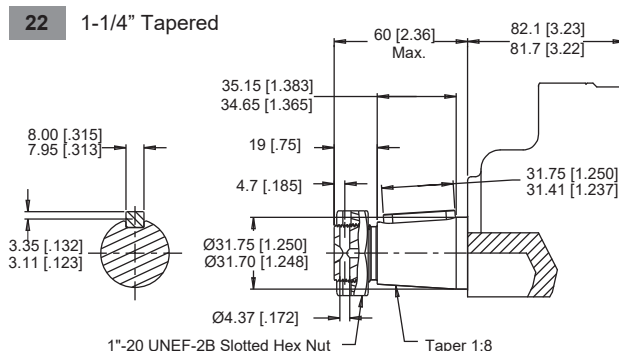
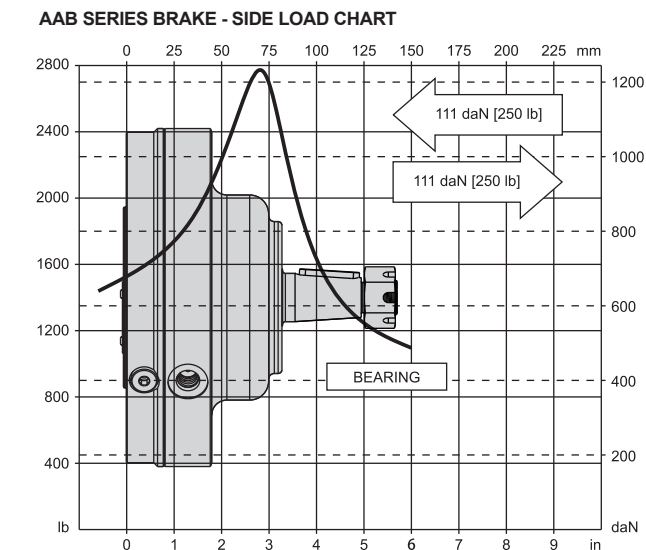
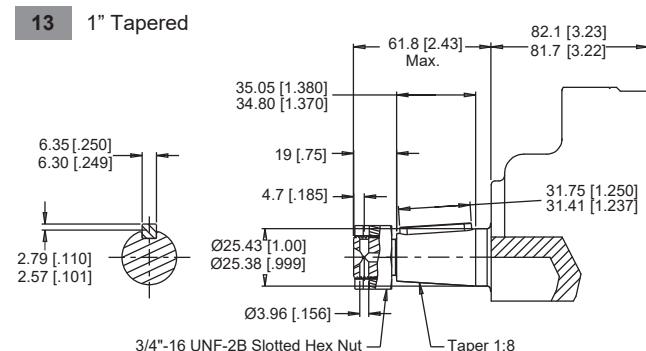
► Dimensions shown are without paint. Paint thickness can be up to 0.13 [.005].

K30 7/16-20 UNF

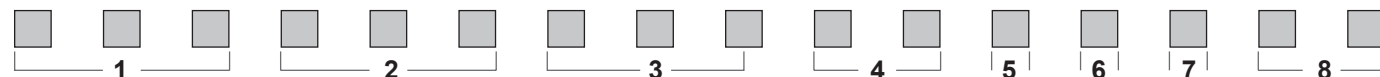


The bearing curve represents allowable bearing loads based on ISO 281 bearing capacity for an L_{10} life of 2,000 hours at 100 rpm. Radial loads for speeds other than 100 rpm may be calculated using the multiplication factor table on page 5.

SHAFTS



ORDERING INFORMATION



1. CHOOSE SERIES DESIGNATION

AAB Hydraulic Brake

2. SELECT A HOLDING TORQUE OPTION

000 475 Nm [4200 lb-in]

3. SELECT A MOUNT & PORT OPTION

K30 4-Hole, Brake Mount, 7/16-20 UNF

4. SELECT A SHAFT OPTION

13 1" Tapered

22 1-1/4" Tapered

5. SELECT A PAINT OPTION

A Black

B Black, Unpainted Mounting Surface

6. SELECT A VALVE CAVITY / CARTRIDGE OPTION

☐ A None

7. SELECT AN ADD-ON OPTION

A Standard

8. SELECT A MISCELLANEOUS OPTION

AA 1.50 [.060] Pilot Height (Standard)

AY	3.18 [.125]	Pilot Height
----	-------------	--------------

AZ 6.35 [.250] Pilot Height

► For options not listed in the table above, please contact us with your requirements.

OVERVIEW

The AFB series is a multi-wet disc brake that provides superior performance. All internal components are fully immersed in pre-filled fluid and are environmentally sealed to prevent contamination and corrosion while providing brake durability and maintaining proper holding capacity. Compact design and large holding torque along with a lower release pressure and lower free turn torque saves your space and reduces cost.

FEATURES / BENEFITS

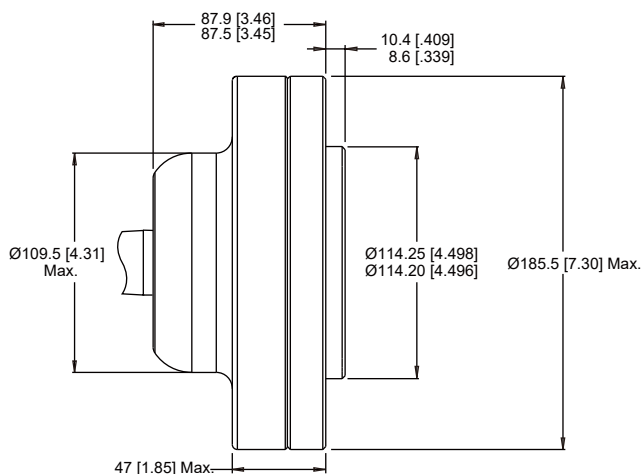
- Compact design.
- Heavy duty roller bearings support higher shaft loads and provide longer shaft seal life.
- Oil-filled cavity immerses all components providing quiet operation.
- Large holding torque with lower release pressure and free turn torque.

TYPICAL APPLICATIONS

Wheel drives, positioners, conveyors, door openers, swing drives, aerial work platforms and more.

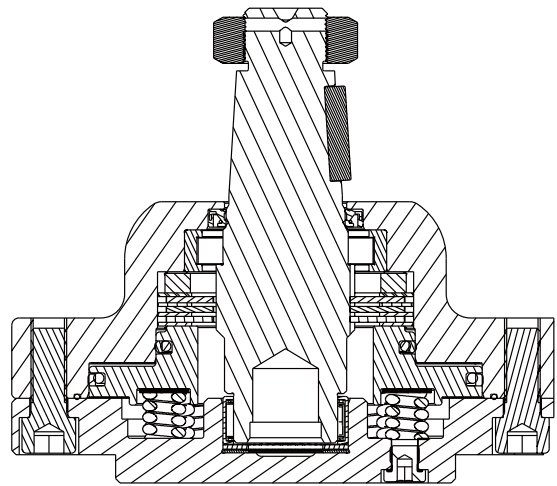
HOUSINGS

4-HOLE, BRAKE MOUNT



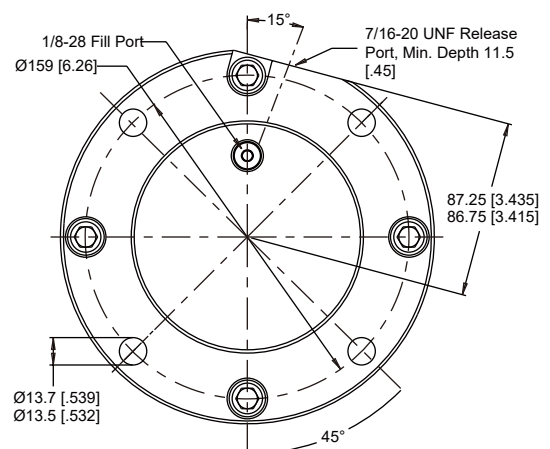
SPECIFICATIONS

Release Pressure	20 bar [290 psi]
Maximum Release Pressure	207 bar [3,000 psi]
Release Volume	9.0 cm ³ [0.55 in ³]
Max. Speed	250 rpm
Max. Operating Temperature	82°C [180°F]
Weight	10.9 kg [24 lb]
Fluid Type	Mineral based oil



► Dimensions shown are without paint. Paint thickness can be up to 0.13 [.005].

K30 7/16-20 UNF



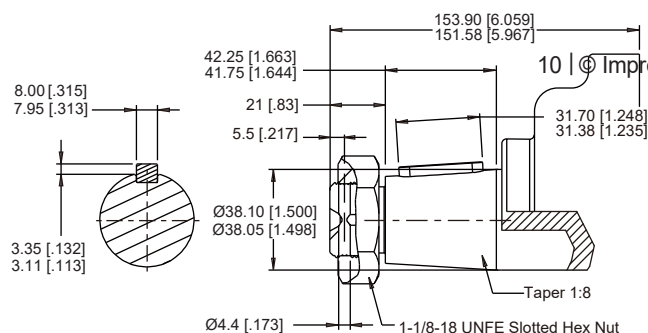
TECHNICAL INFORMATION

ALLOWABLE SHAFT LOAD / BEARING CURVE

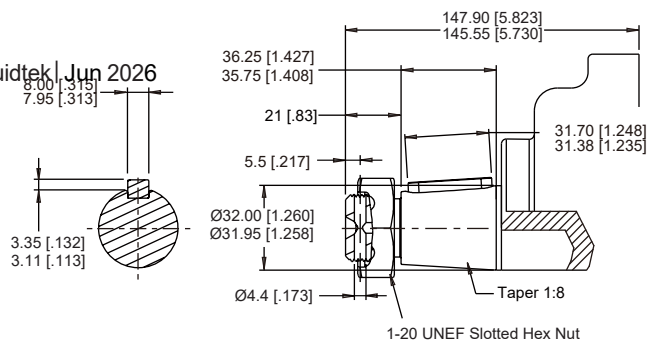
The bearing curve represents allowable bearing loads based on ISO 281 bearing capacity for an L_{10} life of 2,000 hours at 100 rpm. Radial loads for speeds other than 100 rpm may be calculated using the multiplication factor table on page 5.

SHAFTS

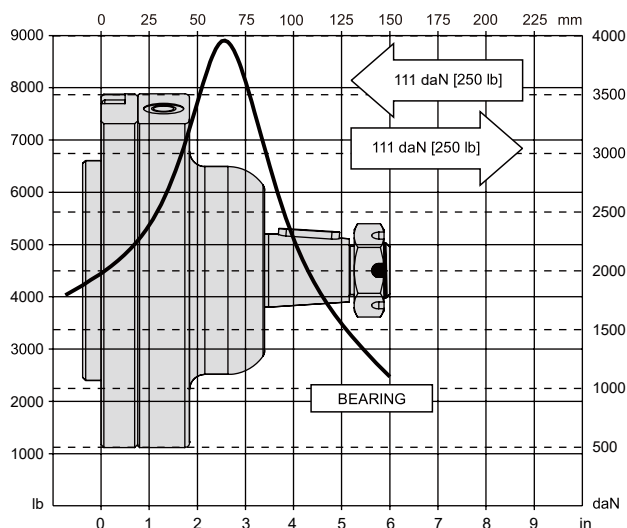
31 1-1/2" Tapered



D7 32mm Tapered



AFB SERIES BRAKE - SIDE LOAD CHART



ORDERING INFORMATION

1	2	3	4	5	6	7	8
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1. CHOOSE SERIES DESIGNATION

AFB Hydraulic Brake

2. SELECT A HOLDING TORQUE OPTION

350 350 Nm [3100 lb-in]
550 550 Nm [4900 lb-in]
650 650 Nm [5750 lb-in]

3. SELECT A MOUNT & PORT OPTION

K30 4-Hole, Brake Mount, 7/16-20 UNF

4. SELECT A SHAFT OPTION

31 1-1/2" Tapered
D7 32mm Tapered

5. SELECT A PAINT OPTION

A Black
B Black, Unpainted Mounting Surface

6. SELECT A VALVE CAVITY / CARTRIDGE OPTION

A None

7. SELECT AN ADD-ON OPTION

A Standard

8. SELECT A MISCELLANEOUS OPTION

AA None

► For options not listed in the table above, please contact us with your requirements.

OVERVIEW

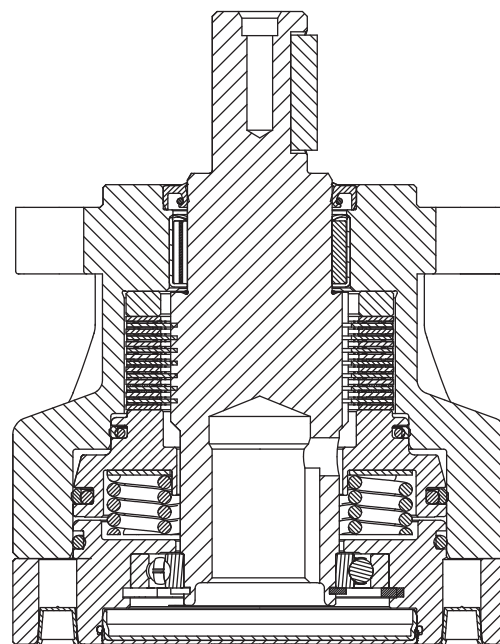
The ASB Series is a robust multi wet-disc brake, which is spring-applied and hydraulically released within a compact design for static brake applications. With an overall diameter of less than 132mm (5.2 inches) it provides up to 620 Nm (5500lb-in) holding torque. Unlike traditional brakes on the market, the ASB brake is specifically designed to integrate seamlessly with a full range of small-frame SAE A mounts and shaft options available on the market. The brake can also be used as a standalone brake solution without an input drive motor. These unique features enhance design flexibility and enable the brake to be easily adapted to a wide range of applications where reliability matters.

FEATURES / BENEFITS

- Multi-wet-disc brake prefilled with oil to extend service life.
- Advanced friction materials for a round brake performance.
- Brake can be easily matched with light duty motors utilizing an SAE A mounting flange or be used as a stand-alone brake.
- Motor operating pressure is decoupled from brake release pressure providing stand-alone functionality.
- A variety of mount and shaft configurations provide flexibility in application design.
- Smooth, quiet, and robust braking performance provides superior service life.
- Global interchangeability with standard motor mounts expedites installation and product integration.

TYPICAL APPLICATIONS

Wheel drives, positioners, conveyors, door openers, swing drives, and more.



SPECIFICATIONS

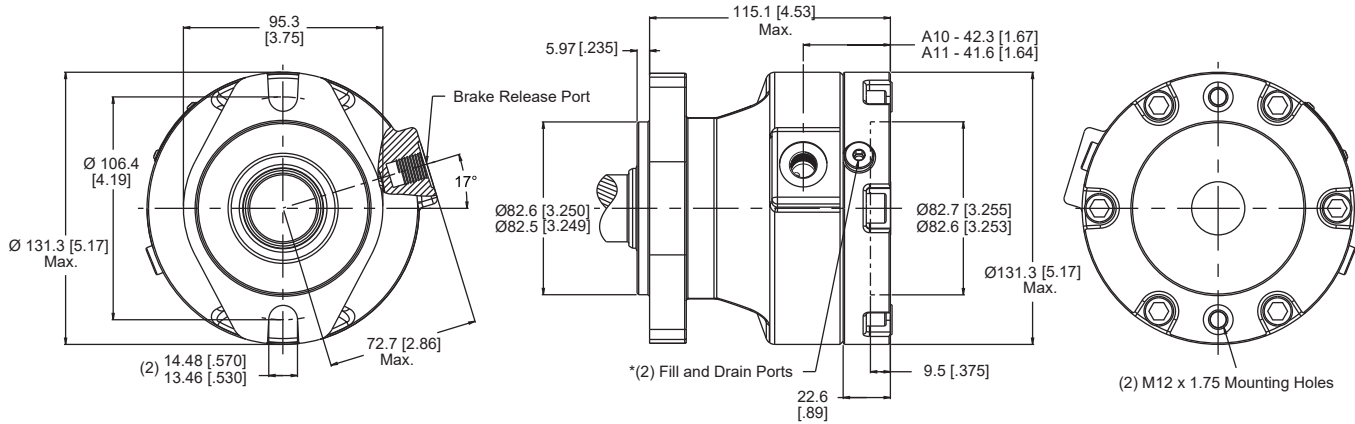
Code	225	315	415	520	620
Holding Torque	225 Nm [2,000 lb-in]	315 Nm [2,800 lb-in]	415 Nm [3,700 lb-in]	520 Nm [4,600 lb-in]	620 Nm [5,500 lb-in]
Max. Release Pressure	207 bar [3,000 psi]				
Full Release Pressure	28 bar [406 psi]	28 bar [406 psi]	28 bar [406 psi]	45 bar [653 psi]	45 bar [653 psi]
Release Volume	8.3 cm ³ [.51 in ³]				
Max. Speed	250 rpm				
Unit Weight	8 kg [17.6 lb]				

HOUSINGS

2-HOLE, SAE A BRAKE MOUNT

A10 7/16-20 UNF

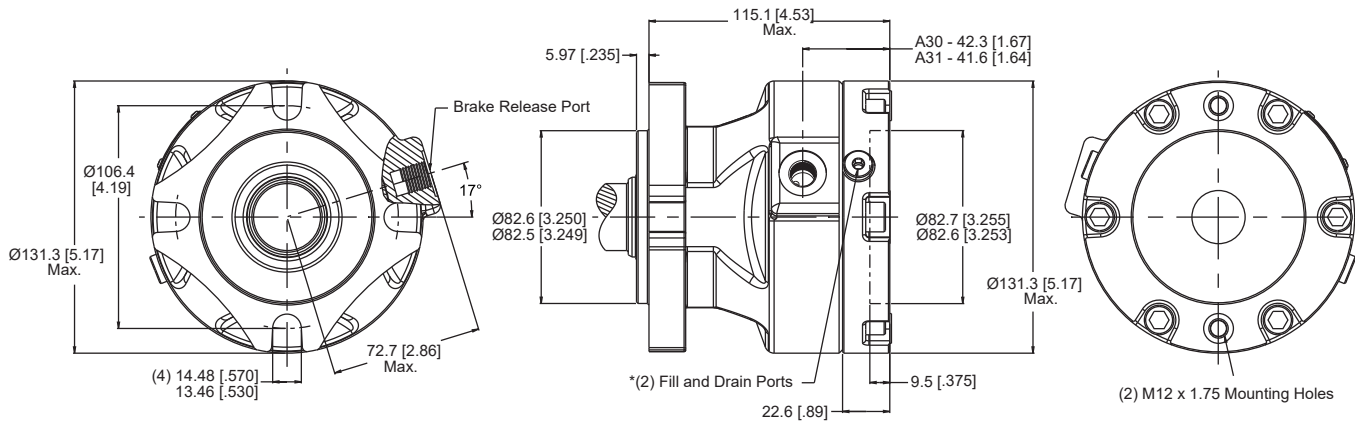
A11 G 1/4



4-HOLE, SAE A BRAKE MOUNT

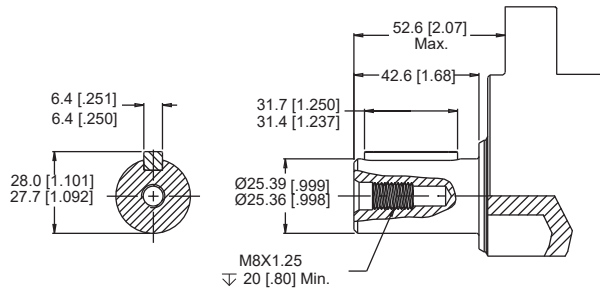
A30 7/16-20 UNF

A31 G 1/4

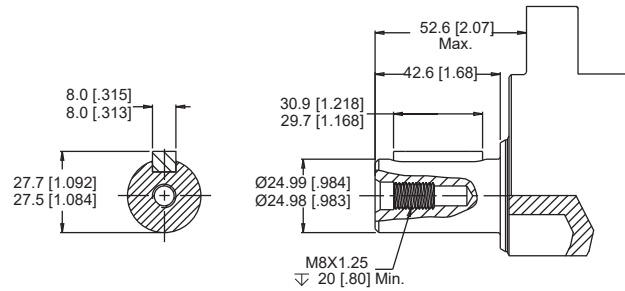


SHAFTS

ZW 1" Straight, 6B Input

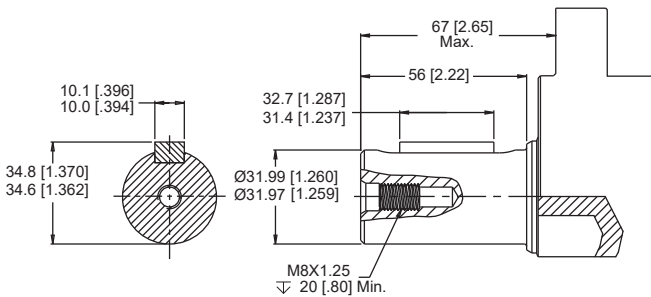


ZY 25mm Straight, 25mm Input



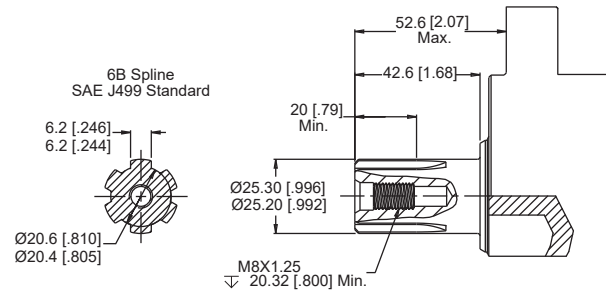
ZT 25mm Straight, 6B Input

ZX 32mm Straight, 25mm Input

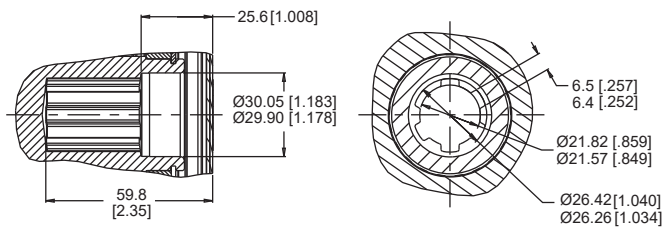


ZU 32mm Straight, 6B Input

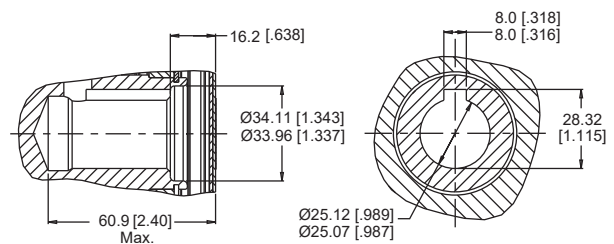
ZZ 6B Spline, 6B Input



6B INPUT DIMENSIONS



25MM INPUT DIMENSIONS



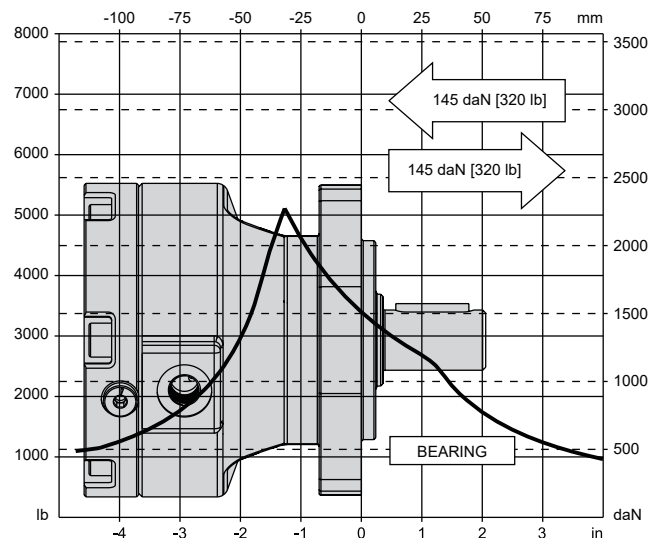
TECHNICAL INFORMATION

ALLOWABLE SHAFT LOAD / BEARING CURVE

The bearing curve represents allowable bearing loads based on ISO 281 bearing capacity for an L_{10} life of 2,000 hours at 100 rpm. Radial loads for speeds other than 100 rpm may be calculated using the multiplication factor table on page 5.



BRAKE MOUNTS



INSTALLATION INFORMATION

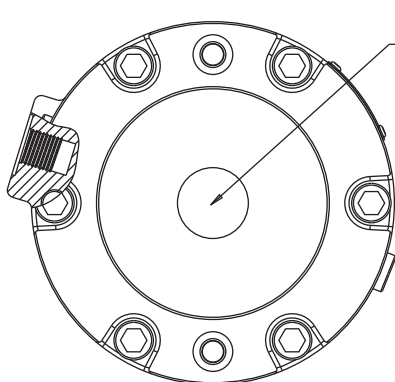
The ASB Brake is a wet multi-disc spring-applied static brake, factory-filled with standard SAE 20 hydraulic oil, which is commonly used in both the brake cavity and hydraulic systems.

The ASB Brake can be mounted to a hydraulic motor to create a complete motor/brake system. A protective shipping cover seals the input interface until installation, which is removed by unscrewing two cap screws and following the motor installation instructions. Make sure the mounting pilot surfaces are free from paint or contaminants for optimal assembly and leak prevention.

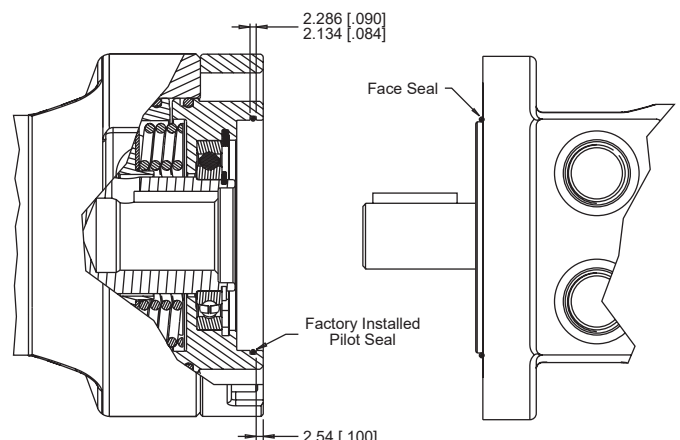
To maintain environmental protection and ensure the bearings are submerged in fluid for lubrication and longevity, the input interface must be properly sealed.

For long pilot motors, an internal seal is included. When using a short pilot motor, an O-ring face seal is necessary to secure the motor/brake interface. Each brake installation kit (part number 930999001) includes two M12 x 1.75 mounting bolts and an O-ring seal, along with installation instructions.

ASB SERIES BRAKE INSTALLATION



To remove cover, pierce and pry with a sharp awl.
When using the ASB Series as a Stand-Alone unit, this cover is not to be removed. It retains oil needed to lubricate the bearings.



- The factory installed pilot seal may be left in place. However, this seal will not provide proper sealing for motors with short pilot mounts, therefore, the face seal contained in the mounting kit must be used.

AA Standard

| 21

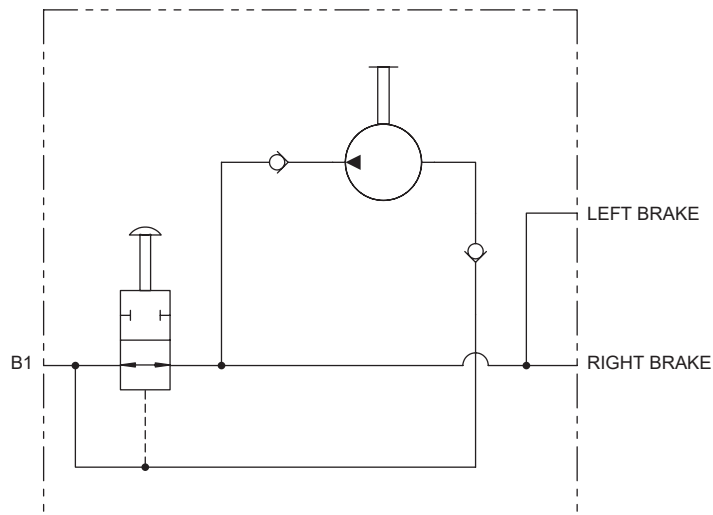
OVERVIEW

HRP series release pump is a compact device for releasing pressure on various types of spring applied hydraulically released brakes. Stable and reliable pressure release with the usage of integrated check valve in a sealed manifold. The combination of RE 550 series motor, ABR series hydraulic brake and HRP series release pump is the best solution for braking of motion drive of aerial work platform.

SPECIFICATIONS

- Typical output flow 1cm³ [.06 in³]- 2cm³ [.12 in³] per stroke depending upon oil viscosity, speed of stroke, and pressure.
- Maximum working pressure of 276 bar [4000 psi].

SCHEMATIC

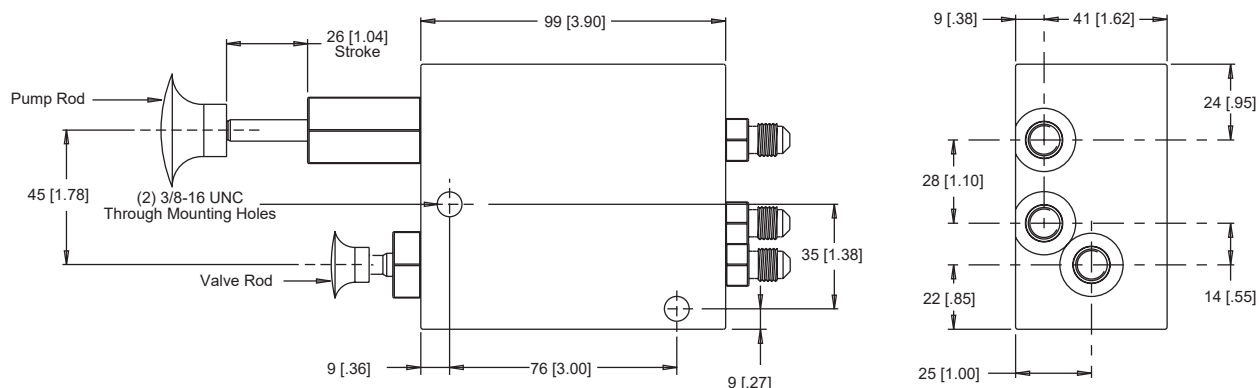


ORDER CODES

HRP020A10AAAA

HRP020A11AAAA

HRP020A12AAAA



► The HRP020A10AAAA has 7/16-20 UNF Ports. The HRP020A11AAAA has #4 JIC fittings pre-installed. The HRP020A12AAAA has G 1/4 Ports.

OVERVIEW

Impro Fluidtek flow dividers deliver precise, reliable flow division through a fundamentally different approach compared to the most common solutions: two gearset assemblies in a common housing, mechanically linked by a drive link. Both gearset assemblies rotate in sync, forcing equal volumes of fluid to each output port. This mechanical coupling eliminates the flow imbalance common in conventional gear dividers, without relying on rotating seals that wear and fail. Because the FX Series operates at a significantly lower RPM than most gear dividers, it runs noticeably quieter. Rated to a maximum system pressure of 207 bar [3000 psi] with output pressure differentials of up to 172 bar [2500 psi], the FX Series is well suited for synchronising actuators, and can be used for pressure intensification by connecting one output to tank.

FEATURES / BENEFITS

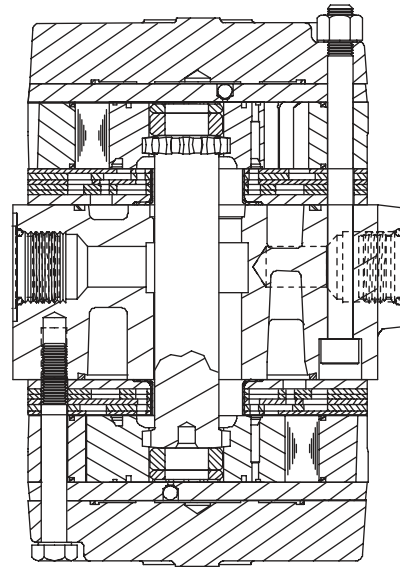
- Precise, synchronised flow division.
- No bearings or rotating seals, eliminating the most common failure modes.
- Quiet operation due to low RPM.
- High pressure differential tolerance.
- Compact design.

TYPICAL APPLICATIONS

Cylinder synchronization, parallel motor circuits, pressure intensification, and more

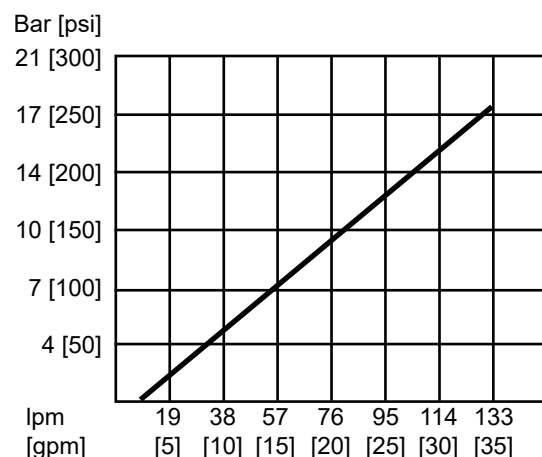
SERIES DESCRIPTIONS

FX - Hydraulic Flow Divider



PRESSURE DROP

Flow dividers are not available with internal relief protection. In-line relief protection for the output lines should be provided due to the possibility of encountering pressure intensification if pressure in one outlet line drops dramatically.



2-WAY FLOW DIVIDER

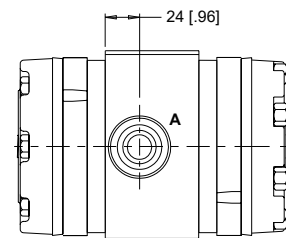
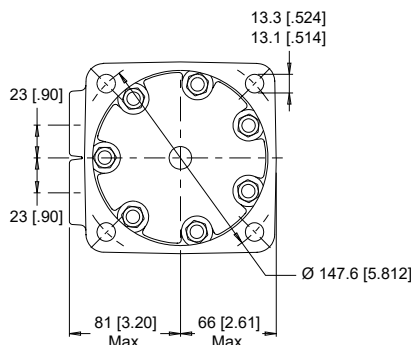
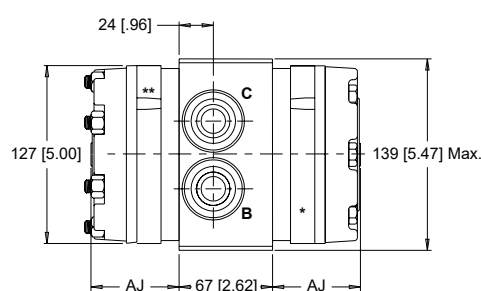
► Dimensions shown are without paint. Paint thickness can be up to 0.13 [.005].

ORDER CODES

950320M8699AAAAA

950600M8699AAAAA

950750M8699AAAAA



► * This displacement affects Output Port B. **This displacement affects Output Port C. For the 950320M8699AAAAA dimension AJ equals 59 [2.32], the flow rate range is 8-38 lpm [2-10 gpm] and has a weight of 15.4 kg [34 lb]. For the 950600M8699AAAAA - dimension AJ equals 71 [2.78], the flow rate range is 30-114 lpm [8-30 gpm] and has a weight of 17.0 kg [37 lb]. For the 950750M8699AAAAA - dimension AJ equals 77 [3.03], the flow rate range is 114-151 lpm [30-40 gpm] and has a weight of 18.0 kg [40 lb]. 950 Series weights vary ± 0.9 kg [2 lb] based on model configuration. By changing the first A in the model code to a Z, the unit will be unpainted instead of the standard black paint. Ports A, B & C are 1 1/16-12 UN.

2-WAY FLOW DIVIDER PERFORMANCE

Inlet Port A lpm [gpm]	Outlet Port B lpm [gpm]	Outlet Port C lpm [gpm]	Rated Accuracy	Inlet Port A bar [psi]	Outlet Port B bar [psi]	Outlet Port C bar [psi]
30 [8]	17.0 [4.49]	13.5 [3.56]	$\pm 13.3\%$	76 [1099]	2 [24]	138 [2003]
38 [10]	20.8 [5.49]	17.3 [4.58]	$\pm 9.5\%$	77 [1109]	2 [32]	139 [2013]
57 [15]	29.9 [7.89]	27.1 [7.15]	$\pm 4.9\%$	79 [1145]	4 [58]	138 [2007]
76 [20]	39.6 [10.46]	36.1 [9.54]	$\pm 5.0\%$	82 [1194]	6 [87]	139 [2009]
95 [25]	49.0 [12.94]	45.4 [11.99]	$\pm 4.4\%$	87 [1263]	9 [123]	139 [2008]
114 [30]	58.3 [15.41]	54.4 [14.38]	$\pm 4.6\%$	93 [1341]	11 [163]	138 [2007]
30 [8]	17.7 [4.68]	12.6 [3.32]	$\pm 18.0\%$	120 [1744]	21 [297]	206 [2991]
38 [10]	21.7 [5.73]	16.3 [4.31]	$\pm 14.2\%$	121 [1756]	21 [300]	207 [3006]
57 [15]	31.3 [8.27]	25.5 [6.74]	$\pm 10.5\%$	123 [1783]	21 [306]	207 [2996]
76 [20]	40.6 [10.72]	34.8 [9.20]	$\pm 8.4\%$	126 [1820]	21 [308]	206 [2993]
95 [25]	49.9 [13.18]	44.0 [11.64]	$\pm 7.4\%$	129 [1875]	21 [305]	207 [3001]
114 [30]	59.2 [15.63]	53.2 [14.05]	$\pm 6.7\%$	134 [1938]	21 [300]	208 [3011]
30 [8]	17.1 [4.52]	13.2 [3.50]	$\pm 14.0\%$	107 [1545]	69 [1003]	138 [2005]
38 [10]	20.7 [5.48]	17.2 [4.54]	$\pm 9.5\%$	107 [1553]	69 [1001]	138 [2001]
57 [15]	30.1 [7.94]	26.6 [7.02]	$\pm 6.7\%$	109 [1584]	69 [1007]	137 [1994]
76 [20]	39.4 [10.42]	35.9 [9.48]	$\pm 5.5\%$	112 [1623]	69 [1001]	138 [2001]
95 [25]	48.6 [12.85]	45.2 [11.95]	$\pm 4.8\%$	116 [1679]	69 [1003]	138 [2005]
114 [30]	58.0 [15.33]	54.3 [14.36]	$\pm 4.7\%$	120 [1742]	69 [1003]	138 [2007]
30 [8]	15.2 [4.03]	15.0 [3.97]	$\pm 1.3\%$	140 [2030]	139 [2008]	138 [2003]
38 [10]	19.1 [5.03]	18.8 [4.97]	$\pm 1.1\%$	140 [2035]	138 [1999]	138 [1996]
57 [15]	28.5 [7.52]	28.1 [7.41]	$\pm 1.4\%$	143 [2075]	138 [2003]	138 [2007]
76 [20]	37.8 [9.99]	37.5 [9.90]	$\pm 1.3\%$	146 [2112]	138 [2005]	138 [1995]
95 [25]	47.1 [12.45]	46.5 [12.29]	$\pm 2.1\%$	150 [2171]	138 [2007]	138 [2003]
114 [30]	56.5 [14.91]	55.7 [14.72]	$\pm 2.3\%$	154 [2232]	138 [2006]	138 [2000]

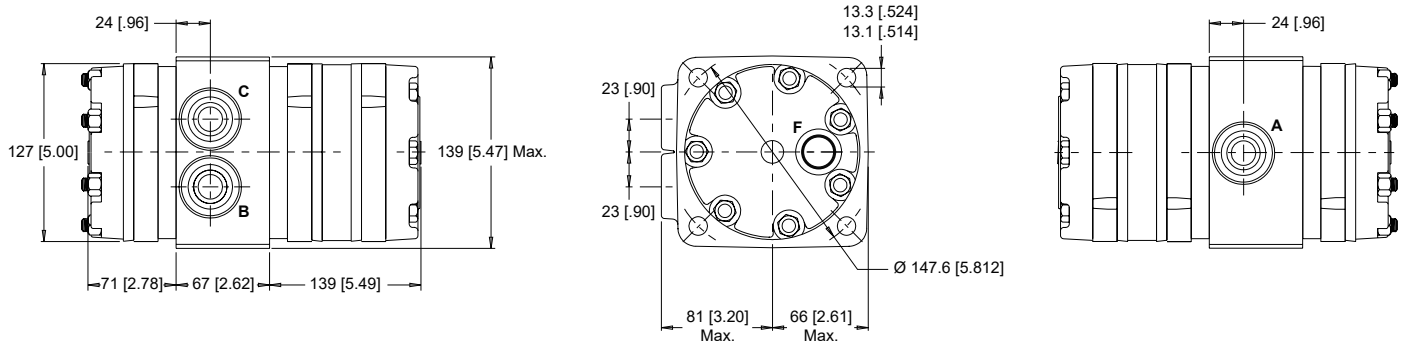
► Performance data is typical. Performance of production units varies slightly from one motor to another. The above data reflects the equal split ratio model 950600M8699AAAAA. Unequal split ratios are also available on the 2-way flow divider. For more information please contact your Customer Service Representative. Performance data was averaged using 3 test units.

3-WAY FLOW DIVIDER

► Dimensions shown are without paint. Paint thickness can be up to 0.13 [.005].

ORDER CODE

950900M8699AAAAA



► The flow rate range is 15-151 lpm [4-40 gpm] and has a weight of 24.1 kg [53 lb]. 950 Series weights vary ± 0.9 kg [2 lb] based on model configuration. By changing the first A in the model code to a Z, the unit will be unpainted instead of the standard black paint. Ports A, B & C are 1 1/16-12 UN. Port F is 7/18-14 UNF.

3-WAY FLOW DIVIDER PERFORMANCE

Inlet Port A lpm [gpm]	Outlet Port B lpm [gpm]	Outlet Port C lpm [gpm]	Outlet Port F lpm [gpm]	Rated Accuracy	Inlet Port A bar [psi]	Outlet Port B bar [psi]	Outlet Port C bar [psi]	Outlet Port F bar [psi]
15 [4]	4.0 [1.06]	5.0 [1.32]	4.3 [1.14]	$\pm 14.0\%$	100 [1452]	0 [5]	139 [2016]	138 [2002]
38 [10]	14.1 [3.71]	12.9 [3.41]	11.2 [2.97]	$\pm 11.6\%$	102 [1481]	1 [20]	140 [2033]	138 [2007]
57 [15]	20.6 [5.44]	19.2 [5.08]	17.2 [4.45]	$\pm 9.5\%$	103 [1491]	2 [32]	138 [2006]	139 [2017]
76 [20]	27.0 [7.13]	25.5 [6.72]	23.5 [6.20]	$\pm 7.2\%$	105 [1522]	3 [48]	139 [2009]	138 [2000]
95 [25]	33.4 [8.83]	31.8 [8.39]	29.6 [7.81]	$\pm 6.5\%$	108 [1562]	5 [67]	138 [2004]	140 [2029]
114 [30]	39.7 [10.49]	37.9 [10.02]	35.7 [9.43]	$\pm 6.1\%$	110 [1597]	6 [89]	139 [2015]	137 [1992]
133 [35]	46.0 [12.16]	44.1 [11.66]	41.7 [11.01]	$\pm 5.9\%$	114 [1650]	8 [113]	138 [2003]	139 [2014]
151 [40]	52.2 [13.79]	50.2 [13.27]	47.7 [12.61]	$\pm 5.2\%$	118 [1707]	9 [136]	138 [1999]	138 [2007]
15 [4]	6.9 [1.83]	5.2 [1.37]	3.1 [0.82]	$\pm 38.0\%$	155 [2249]	21 [303]	205 [2980]	208 [3018]
38 [10]	15.0 [3.96]	12.6 [3.32]	10.6 [2.80]	$\pm 18.4\%$	155 [2251]	21 [301]	207 [2996]	207 [3003]
57 [15]	21.5 [5.69]	18.9 [4.99]	16.6 [4.39]	$\pm 13.2\%$	156 [2267]	21 [303]	207 [2997]	206 [2989]
76 [20]	28.1 [7.42]	25.1 [6.64]	22.7 [6.00]	$\pm 10.9\%$	158 [2299]	21 [303]	206 [2995]	207 [2997]
95 [25]	34.6 [9.14]	31.4 [8.29]	28.8 [7.60]	$\pm 9.3\%$	161 [2332]	21 [300]	207 [2997]	206 [2991]
114 [30]	41.0 [10.84]	37.5 [9.91]	34.7 [9.18]	$\pm 8.7\%$	164 [2379]	21 [301]	207 [3008]	207 [2999]
133 [35]	47.4 [12.52]	43.6 [11.53]	40.6 [10.73]	$\pm 8.4\%$	167 [2418]	21 [299]	205 [2975]	205 [2978]
151 [40]	53.6 [14.16]	49.5 [13.08]	46.9 [12.40]	$\pm 6.8\%$	176 [2550]	20 [295]	207 [2998]	206 [2992]
15 [4]	5.8 [1.52]	5.2 [1.38]	4.2 [1.11]	$\pm 16.0\%$	119 [1722]	69 [1000]	138 [2004]	139 [2016]
38 [10]	13.4 [3.54]	12.8 [3.37]	11.9 [3.15]	$\pm 6.1\%$	119 [1728]	69 [994]	138 [2002]	138 [1995]
57 [15]	19.7 [5.21]	19.0 [5.03]	18.1 [4.78]	$\pm 4.7\%$	121 [1753]	69 [1004]	138 [2007]	138 [1994]
76 [20]	26.2 [6.91]	25.4 [6.70]	24.3 [6.41]	$\pm 4.1\%$	123 [1780]	69 [1004]	137 [1990]	138 [1999]
95 [25]	32.5 [8.59]	31.6 [8.36]	30.4 [8.03]	$\pm 4.0\%$	125 [1816]	69 [1002]	138 [2003]	138 [1998]
114 [30]	38.8 [10.26]	37.8 [9.99]	36.5 [9.63]	$\pm 3.9\%$	128 [1853]	69 [1003]	138 [1999]	138 [1998]
133 [35]	45.1 [11.90]	44.0 [11.62]	42.5 [11.22]	$\pm 4.1\%$	131 [1896]	69 [1003]	138 [1996]	138 [2002]
151 [40]	51.3 [13.55]	50.1 [13.24]	48.6 [12.83]	$\pm 3.4\%$	134 [1943]	69 [1005]	138 [1997]	138 [1998]
15 [4]	5.0 [1.33]	5.0 [1.32]	5.1 [1.36]	$\pm 2.0\%$	140 [2026]	139 [2010]	138 [2001]	138 [1995]
38 [10]	12.7 [3.35]	12.6 [3.32]	12.8 [3.37]	$\pm 1.1\%$	141 [2051]	139 [2011]	138 [2006]	138 [2008]
57 [15]	19.0 [5.02]	18.8 [4.98]	19.0 [5.02]	$\pm 1.1\%$	142 [2063]	138 [1997]	138 [2001]	138 [1994]
76 [20]	25.4 [6.70]	25.2 [6.65]	25.3 [6.67]	$\pm 0.5\%$	144 [2095]	138 [2000]	138 [2000]	138 [2002]
95 [25]	31.6 [8.36]	31.4 [8.31]	31.4 [8.31]	$\pm 0.8\%$	147 [2128]	138 [2004]	138 [1996]	138 [1996]
114 [30]	37.9 [10.02]	37.7 [9.96]	37.6 [9.93]	$\pm 1.1\%$	149 [2167]	138 [2001]	138 [2003]	138 [2001]
133 [35]	44.1 [11.64]	43.8 [11.57]	43.6 [11.52]	$\pm 1.7\%$	152 [2207]	138 [1999]	138 [1999]	138 [1994]
151 [40]	50.2 [13.26]	50.0 [13.21]	49.6 [13.11]	$\pm 1.5\%$	155 [2252]	138 [1995]	137 [1994]	138 [1998]

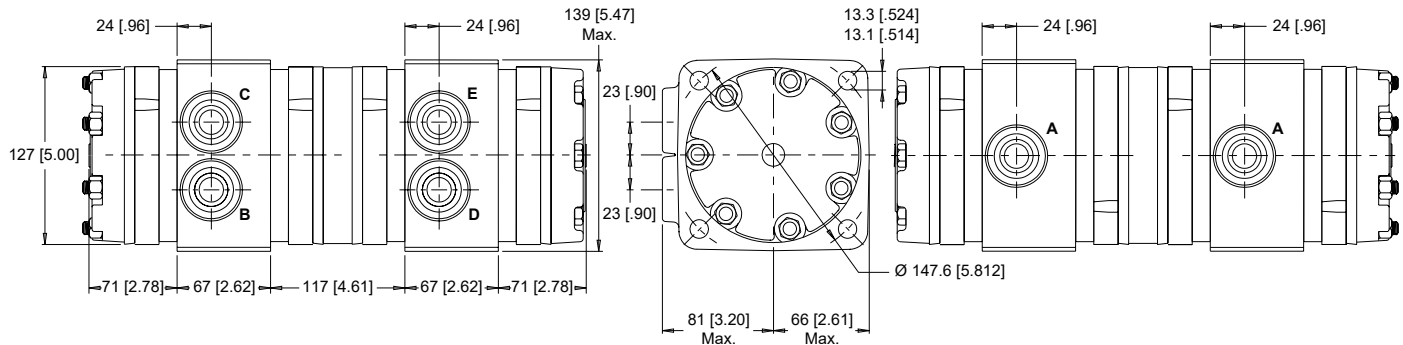
► Performance data is typical. Performance of production units varies slightly from one motor to another. Performance data was averaged using 3 test units.

4-WAY FLOW DIVIDER

► Dimensions shown are without paint. Paint thickness can be up to 0.13 [.005].

ORDER CODE

9501K2M8699AAAAA



► The flow rate range is 15-189 lpm [4-50 gpm] and has a weight of 34.9 kg [77 lb]. 950 Series weights vary ± 0.9 kg [2 lb] based on model configuration. By changing the first A in the model code to a Z, the unit will be unpainted instead of the standard black paint. Ports A, B, C, D & E are 1 1/16-12 UN.

4-WAY FLOW DIVIDER PERFORMANCE

Inlet Port A lpm [gpm]	Outlet Port B lpm [gpm]	Outlet Port C lpm [gpm]	Outlet Port D lpm [gpm]	Outlet Port E lpm [gpm]	Rated Accuracy	Inlet Port A bar [psi]	Outlet Port B bar [psi]	Outlet Port C bar [psi]	Outlet Port D bar [psi]	Outlet Port E bar [psi]
15 [4]	4.7 [1.25]	3.2 [0.86]	3.7 [0.97]	3.6 [0.95]	$\pm 25.3\%$	113 [1636]	0 [3]	137 [1990]	137 [1989]	138 [2002]
38 [10]	11.2 [2.95]	8.8 [2.33]	9.2 [2.43]	9.0 [2.39]	$\pm 17.9\%$	112 [1622]	1 [7]	138 [1996]	138 [2002]	139 [2014]
57 [15]	15.8 [4.17]	13.5 [3.57]	13.9 [3.67]	13.8 [3.65]	$\pm 10.9\%$	112 [1620]	1 [18]	138 [2005]	138 [1996]	138 [2001]
76 [20]	20.6 [5.45]	18.0 [4.76]	18.6 [4.91]	18.6 [4.91]	$\pm 8.4\%$	114 [1648]	2 [28]	140 [2024]	138 [2002]	137 [1993]
95 [25]	25.4 [6.72]	22.7 [6.01]	23.2 [6.12]	23.3 [6.15]	$\pm 6.9\%$	115 [1671]	3 [39]	137 [1994]	139 [2011]	138 [2009]
114 [30]	30.2 [7.98]	27.3 [7.22]	27.7 [7.33]	27.9 [7.38]	$\pm 6.0\%$	118 [1708]	4 [53]	138 [1997]	138 [2000]	138 [2005]
133 [35]	35.0 [9.25]	31.9 [8.44]	32.2 [8.52]	32.5 [8.58]	$\pm 5.3\%$	120 [1744]	4 [65]	138 [2001]	138 [2000]	138 [2008]
151 [40]	39.8 [10.51]	36.5 [9.66]	36.7 [9.71]	37.1 [9.79]	$\pm 5.4\%$	123 [1784]	6 [81]	138 [1999]	137 [1990]	138 [2001]
15 [4]	5.4 [1.42]	3.1 [0.81]	3.7 [0.98]	3.2 [0.83]	$\pm 44.0\%$	171 [2483]	21 [309]	206 [2993]	207 [2995]	207 [3002]
38 [10]	12.0 [3.16]	8.4 [2.22]	9.3 [2.46]	8.5 [2.24]	$\pm 26.3\%$	170 [2470]	21 [299]	207 [3000]	207 [3002]	207 [2998]
57 [15]	17.2 [4.54]	12.8 [3.39]	13.9 [3.67]	13.1 [3.47]	$\pm 20.7\%$	171 [2481]	21 [304]	207 [3004]	207 [3003]	206 [2994]
76 [20]	22.4 [5.92]	17.1 [4.52]	18.6 [4.90]	17.8 [4.70]	$\pm 17.9\%$	172 [2501]	21 [302]	207 [3002]	207 [3009]	207 [2998]
95 [25]	27.5 [7.25]	21.6 [5.71]	23.1 [6.10]	22.4 [5.92]	$\pm 15.8\%$	174 [2525]	21 [304]	206 [2994]	207 [3001]	207 [3006]
114 [30]	32.5 [8.58]	26.2 [6.93]	27.6 [7.30]	26.9 [7.12]	$\pm 14.0\%$	176 [2557]	21 [302]	207 [3002]	207 [3008]	207 [2999]
133 [35]	37.4 [9.88]	30.6 [8.09]	32.2 [8.51]	31.6 [8.34]	$\pm 12.5\%$	179 [2595]	21 [302]	207 [3007]	207 [2998]	207 [3002]
151 [40]	42.5 [11.22]	35.1 [9.28]	36.6 [9.68]	36.0 [9.51]	$\pm 12.6\%$	182 [2636]	21 [299]	207 [3008]	207 [3002]	208 [3011]
15 [4]	4.7 [1.23]	3.4 [0.91]	3.7 [0.96]	3.5 [0.92]	$\pm 25.3\%$	124 [1797]	69 [997]	138 [2006]	138 [2007]	137 [1990]
38 [10]	10.3 [2.73]	9.1 [2.40]	9.5 [2.51]	9.2 [2.44]	$\pm 8.4\%$	124 [1798]	69 [1005]	137 [1993]	137 [1994]	137 [1992]
57 [15]	15.1 [3.99]	13.8 [3.63]	14.1 [3.72]	14.0 [3.69]	$\pm 6.0\%$	125 [1814]	69 [996]	137 [1989]	138 [2001]	137 [1992]
76 [20]	20.0 [5.29]	18.4 [4.85]	18.7 [4.94]	18.6 [4.92]	$\pm 5.3\%$	127 [1841]	69 [1007]	138 [2006]	138 [1999]	138 [2001]
95 [25]	24.9 [6.58]	23.0 [6.09]	23.3 [6.15]	23.3 [6.16]	$\pm 4.8\%$	129 [1864]	69 [1001]	138 [2002]	138 [2002]	137 [1992]
114 [30]	29.6 [7.83]	27.7 [7.33]	27.8 [7.36]	27.9 [7.37]	$\pm 3.9\%$	131 [1899]	69 [1007]	138 [2000]	138 [2004]	138 [2000]
133 [35]	34.3 [9.08]	32.4 [8.57]	32.4 [8.56]	32.5 [8.59]	$\pm 3.2\%$	133 [1932]	69 [1004]	138 [1996]	138 [2002]	138 [1999]
151 [40]	39.0 [10.32]	37.1 [9.79]	36.9 [9.75]	37.1 [9.81]	$\pm 3.3\%$	136 [1966]	69 [996]	137 [1994]	137 [1993]	138 [1997]
15 [4]	3.8 [1.01]	3.8 [0.99]	3.8 [1.01]	3.8 [1.00]	$\pm 1.3\%$	140 [2025]	139 [2010]	139 [2011]	139 [2009]	138 [2007]
38 [10]	9.6 [2.53]	9.4 [2.49]	9.6 [2.53]	9.5 [2.51]	$\pm 1.1\%$	140 [2033]	138 [1997]	138 [1999]	138 [1999]	138 [2002]
57 [15]	14.3 [3.78]	14.2 [3.74]	14.2 [3.76]	14.2 [3.75]	$\pm 0.4\%$	142 [2054]	138 [2001]	138 [1997]	138 [2002]	138 [2000]
76 [20]	19.1 [5.04]	18.9 [4.99]	18.8 [4.98]	18.9 [5.00]	$\pm 4.7\%$	143 [2076]	138 [1995]	137 [1993]	138 [2002]	138 [1996]
95 [25]	23.8 [6.30]	23.6 [6.24]	23.5 [6.20]	23.6 [6.25]	$\pm 0.6\%$	145 [2108]	138 [2002]	138 [1999]	138 [2004]	138 [1999]
114 [30]	28.6 [7.55]	28.3 [7.48]	28.0 [7.40]	28.3 [7.47]	$\pm 0.7\%$	148 [2140]	138 [2002]	138 [1999]	138 [2002]	138 [2000]
133 [35]	33.3 [8.79]	33.0 [8.71]	32.5 [8.60]	32.9 [8.69]	$\pm 2.9\%$	150 [2175]	138 [2002]	138 [2005]	138 [1998]	138 [2000]
151 [40]	38.0 [10.03]	37.6 [9.94]	37.0 [9.77]	37.4 [9.89]	$\pm 2.0\%$	153 [2218]	138 [1997]	138 [2008]	138 [2002]	138 [2005]

► Performance data is typical. Performance of production units varies slightly from one motor to another. Performance data was averaged using 3 test units.



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