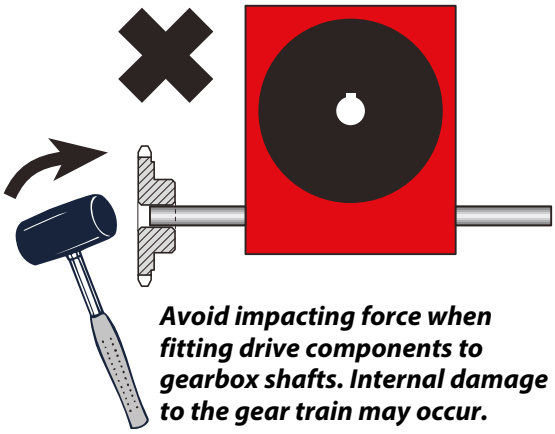
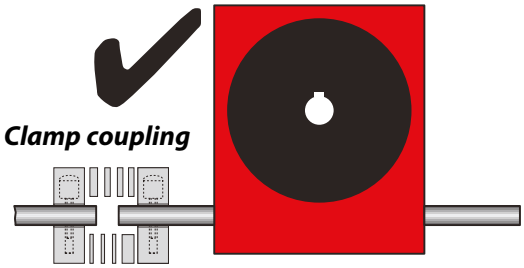
PRECISION GEARBOXES

Mounting Instructions

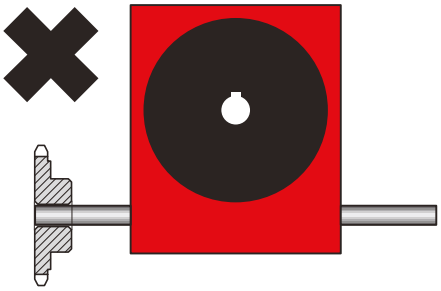
TECHNICAL



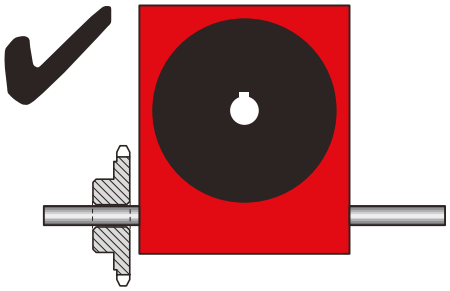
Avoid impacting force when fitting drive components to gearbox shafts. Internal damage to the gear train may occur.



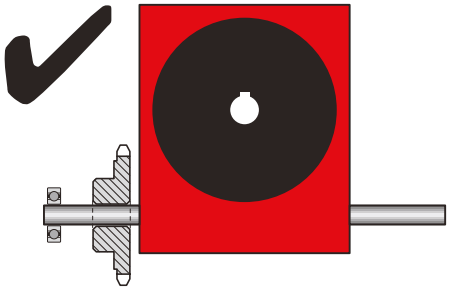
Clamp couplings avoid damage to the shaft and absorb misalignment.



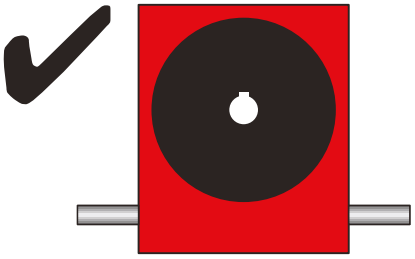
Gear, pulley or sprocket mounted at the outer extremity of the input shaft may induce bending and eventual failure of the shaft.



Mounting the gear, pulley or sprocket as near as possible to the gearbox body helps reduce leverage on the shaft, although shaft fatigue may still result.



An outrigger bearing supports the shaft thus minimising the bending load and protecting the shaft from failure.



We always recommend any modifications that the customer may require in terms of gearbox shaft length, diameters or keyway configurations be made by us prior to assembly. Alterations undertaken by the customer on a finished box may lead to internal gear damage and subsequent premature failure of the gearbox.

Modifications undertaken by customers will invalidate the warranty.

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PRECISION GEARBOXES

Gearbox Lubrication and Operating Conditions

- Operating ambient temperature range = 0°C to 70°C
- The grease in most applications will run at 80°C but if speed and load are increased, the temperature of the gearbox will rise and may cause damage to the unit. Hand motion will not cause a problem because no thermal build up will arise until you motor power the unit.
- Gearboxes can be packed with wide-range temperature grease operating between -55°C to +155°C.
- Rubber seals (nitrile) oil seals: maximum operating temperature = +100°C
- Carbon steel bearings: maximum operating temperature = +150°C (if fitted with high temperature grease and ZZ Steel shields)
- Stainless steel bearings: maximum operating temperature = +288°C (if fitted with high temperature grease and ZZ Steel shields)
- Standard bearings: maximum operating temperature = +80°C (including hand motion)
- Gearboxes are greased for life. Refilling is only required when boxes are disassembled for refurbishment. Overfilling will cause excessive heat build up and potential failure.
- We are able to modify standard gearboxes to customer's specific requirements.
- Damage caused by customer modifications will invalidate the gearbox guarantee.
- We recommend that shafts are connected by flexible couplings.
- Our gearboxes are designed as speed reducing units, not as multipliers. If used in a speed increasing capacity, service life is not guaranteed.
- Customers will always need to test the units themselves in their particular application to ensure it is adequate for the job and has the desired results for them.

DO NOT FILL !
GREASED FOR LIFE

X

Greasing is only required if the gearbox is to be used in special applications or if it is being refurbished

TECHNICAL

PRECISION GEARBOXES

General Specifications

Torque Figures

Torque figures are maximum torque at gearbox output based on a continuous daily duty cycle at ambient temperature.

Torque figures are to be used for guidance only. You will need to assess duty, cycles and confirm gearbox suitability with your own calculations.

Keyways and Bores

All bores are toleranced to H7 ISO 286 as standard unless stated. Keyways allow use of parallel DIN 6885 keys with easy sliding fit. Tolerances may vary due to manufacturing processes.

Backlash

Figures given are at output of gearbox.

Backlash in planetary gearboxes is dependant on ratio.

Thrust & Overhung Loads

Based on an input speed of 1000rpm taking full torque load and combined thrust and overhung load.

$$i = \frac{n_2}{n_1}$$

$$T = \frac{P \times 9550}{n}$$

$$T_1 = \frac{T_2}{i} \times \frac{100}{\eta}$$

$$T_2 > T_{required} \times K_a$$

Application factor K_a

i	= *Ratio*
n	= *Speed (rpm)*
n_1	= *Input speed (rpm)*
n_2	= *Output speed (rpm)*
T	= *Torque (Nm)*
T_1	= *Input torque (Nm)*
T_2	= *Output torque (Nm)*
P	= *Power (kW)*
η	= *Efficiency (%)*
$T_{required}$	= *Torque to drive application (Nm)*

Working characteristics of driving machine	Working characteristics of driven machine			
	Uniform	Light Shocks	Moderate Shocks	Heavy Shocks
Uniform	1.00	1.25	1.50	1.75
Light Shocks	1.10	1.35	1.60	1.85
Moderate Shocks	1.25	1.50	1.75	2.00
Heavy Shocks	1.50	1.75	2.00	2.25+

PRECISION GEARBOXES

Inertia and the Use of Inertia Figures to Aid Selection

$T_a = J \times a$

$\alpha = \frac{\omega_2 - \omega_1}{t}$

$J_T = J_m + \frac{J_L}{i^2 \times \eta}$

T_a = *Acceleration torque (Nm)*
J = *Inertia (kg.m²)*
J_T = *Total reflected inertia at gearbox input (kg.m²)*
J_m = *Reflected inertia of gearbox (kg.m²)*
J_L = *Inertia of load (kg.m²)*
t = *Acceleration time (sec)*
i = *Ratio*
α = *Angular acceleration (rads/sec²)*
ω = *Angular/Rotational Velocity (rads/sec)*
η = *Efficiency (%)*

Example:
Assume a 3:1 ratio, 90% efficient gearbox with a reflect inertia of 0.00052kg.m².
Torque required at output to drive load is 1Nm

If we were to accelerate the gearbox from rest to 500 rpm in 1.5 seconds the acceleration would be as follows:
500 rpm = (360 x 500)° per minute = 180000° per minute
180000° per minute = (180000 / 60)° per sec = 3000° per sec.
3000 ° per sec = (π/180) * 3000 = 52.36 rads per sec
So, acceleration = 52.36/1.5 = 34.91 rads per sec²

Input torque to accelerate gearbox = 0.00052 x 34.91 = 0.01815Nm

If an inertia load J_L was put on the gearbox output of 0.0062 kg.m² the total inertia at the gearbox input would become 0.00053kg.m²

New input torque to accelerate gearbox	= 0.00053 x 34.91	= 0.01850Nm
Input torque to drive load	= (1/3 x 100/90)	= 0.37037Nm
Total input torque required at start up	= 0.37037 + 0.01850	= 0.38887Nm ≈ 0.39Nm

A margin needs to be added to account for inertia of connecting shafts/couplings, motor rotor inertia and friction from bearings and other elements.

1 radian (rad)	= 57.5928°	$1.0 \times 10^{-2} = 0.01$
1 kg m²	= 10,000 kg cm²	$1.0 \times 10^{-3} = 0.001$
1 kg m²	= 1,000,000,000 g mm²	$1.0 \times 10^{-4} = 0.0001$
1 m²	= 1,000,000 mm²	$1.0 \times 10^{-5} = 0.00001$
1 m²	= 10,000 cm²	$1.0 \times 10^{-6} = 0.000001$
		$1.0 \times 10^{-7} = 0.0000001$

TECHNICAL

PRECISION GEARBOXES

Grease Technical Data

Shell Gadus S5 V42P 2.5 (Formerly called Nerita Grease HV)

TECHNICAL

Shell Gadus S5 V42P 2.5 - Synthetic High Speed Bearing Grease

A very high performance grease specially designed for the lubrication of heavily loaded, high-speed bearings. It consists of a blend of lithium soap, Shell XHVI synthetic base oil and carefully selected additives recommended for use where conventional greases are inadequate in anti-wear and extreme-pressure properies or in their oxidation resistance. Suitable over a wide temperature range from -30°C to a peak of +130°C, it gives extended bearing and grease life.

Performance Features

- Outstanding mechanical stability
- Long operational life
- Lead and nitrite free
- Wide operating temperature range
- Excellent wear protection
- Heavy load capability
- Good oil separation

Typical Physical Characteristics

NLGI Consistency	2.5
Colour	Light Brown
Soap Type	Lithium
Base Oil (type)	Synthetic
Kinematic Viscosity (IP 71/ASTM-D445)	
40°C ^{CS}T	42
100°C ^{CS}T	8
Dropping Point (IP 132/ASTM-D566-76)	180°C
Cone Penetration Worked @ 25°C (IP 50/ASTM-D217)	
60 Strokes	250 - 280
100,000 Strokes change 0.1mm	+20 max.
Oil Separation on Storage of Grease (IP 121)	
7 days @ 40°C	4.8%
Emcor Steel Corrosion Test (IP 220)	
Distilled water 0 - 5 scale	0 - 0
Mechanical Stability (SKF V2F)	Pass
Bearing Life	
FAG FE9 Test @ 150°C L50 hours	> 250
SKF ROF Test @ 130°C L50 hours	> 1500
Extreme Pressure Properties (IP 239/ASTM-D2596)	
Shell Four Ball Test, Load at which welding occurs	315kg
Timken Wear & Lubricant Testing Machine, OK Load	50lbs
Minimum Operating Temperature	-30°C
Maximum Operating Temperature	+130°C

These characteristics are typical of current production. Whilst future production will conform to Shell's specification, variations in these characteristics may occur.

Health & Safety

Shell Gadus S5 V42P 2.5 is unlikely to present any significant health or safety hazard when properly used in the recommended application and good standards of industrial and personal hygiene are maintained. For further guidance on Product Health & Safety refer to the appropriate data sheet.

PRECISION GEARBOXES

Grease Technical Data

Shell Gadus S2 V220AD 2 (Formerly called Alvania HDX 2)

TECHNICAL

Shell Gadus S2 V220AD 2 - High Performance Grease Containing Solid Lubricant

A very high performance grease for the lubrication of industrial bearings subjected to the most arduous conditions. It is based on a high viscosity index mineral oil and a lithium/calcium thickener and contains extreme-pressure, anti-oxidation, anti-wear, anti-corrosion and adhesion additives. It also contains molybdenum disulphide to enhance its EP properties. The essential qualities of Shell Gadus S2 V220AD 2 are its mechanical stability, water resistance, adhesion and exceptional performance in shock loaded conditions. It is recommended for the lubrication of shock loaded heavy duty bearings working in damp hostile conditions.

Performance Features

- Excellent mechanical stability
- For shock loaded conditions
- Extreme pressure performance
- Good water resistance
- Good adhesion properties

Typical Physical Characteristics

NLGI Consistency	2
Colour	Dark grey
Soap Type	Lithium/Calcium
Base Oil (type)	Mineral
Kinematic Viscosity (IP 71/ASTM-D445)	
40°C $^{C}S^{T}$	160
100°C $^{C}S^{T}$	15.5
Cone Penetration	
Worked @ 25°C 0.1mm (IP 50/ASTM-D217)	265 - 295
Dropping Point (IP 132/ASTM-D566-76)	184°C
Water Resistance	
Water Wash-out (ASTM-D1264)	3%
Water Spray-off (ASTM-D4049)	4.2%
Emcor Steel Corrosion Test (IP 220)	
Distilled water 0 - 5 scale	0 - 0
Mechanical Stability (SKF V2F)	
Condition 1 (50g max.)	Pass
Extreme Pressure Properties (IP 239/ASTM-D2596)	
Shell Four Ball Test, Load at which welding occurs	400kg
Minimum Operating Temperature	-10°C
Maximum Operating Temperature	+120°C (+140°C peak)

These characteristics are typical of current production. Whilst future production will conform to Shell's specification, variations in these characteristics may occur.

Health & Safety

Shell Gadus S2 V220AD 2 is unlikely to present any significant health or safety hazard when properly used in the recommended application and good standards of industrial and personal hygiene are maintained. For further guidance on Product Health & Safety refer to the appropriate data sheet.

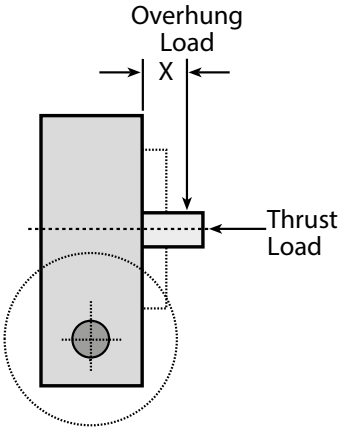
PRECISION GEARBOXES

Thrust Loads

TECHNICAL

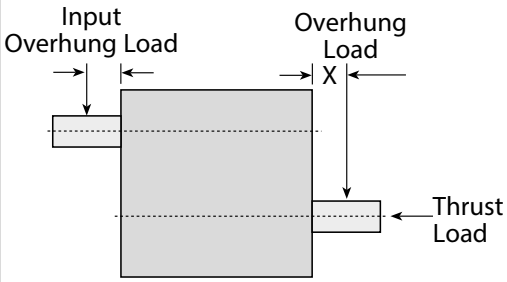
The following tables are based on an input speed of 1,000 rpm taking full load torque plus overhung load and thrust load:-

P PF BP TYPE
Worm & Wheel Gearboxes



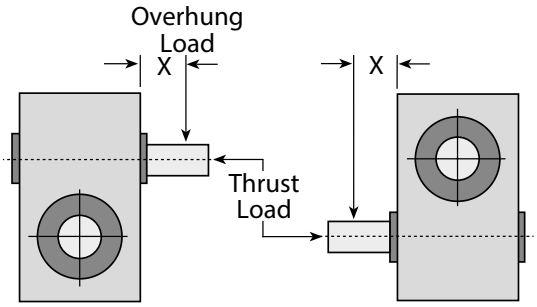
Part Number		Output Shaft Distance 'X'mm	Overhung Load kg	Thrust Load kg	Input Overhung Load kg
P15	PF15	10	8	3	4
P20	PF20	10	12	5	6
P30	PF30	12	20	12	8
P40	PF40	15	30	20	10
P45	PF45	20	45	30	12
P55	PF55	20	60	40	14
P60	PF60	25	70	50	16
P70	PF70	30	80	60	20
	BP50	25	60	40	20
	BP60	30	80	60	25

PP TYPE
Double Reduction Gearboxes



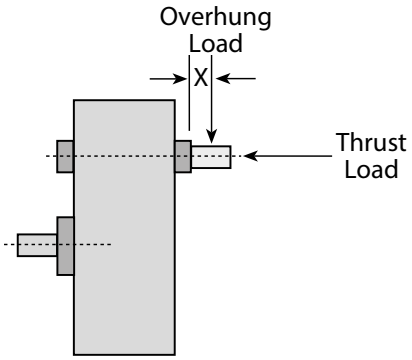
Part Number	Output Shaft Distance 'X'mm	Overhung Load kg	Thrust Load kg	Input Overhung Load kg
PP35	12	12	10	6
PP50	20	30	20	10
PP60	25	45	35	15

E TYPE
Crossed Helical Gearboxes



Part Number	Output Shaft Distance 'X'mm	Overhung Load kg	Thrust Load kg
E15	6	15	10
E20	6	15	10
E30	10	20	15
E40	12	40	30
E50	20	60	40
E60	25	80	50

FF TYPE
Spur Gear Reduction Gearboxes



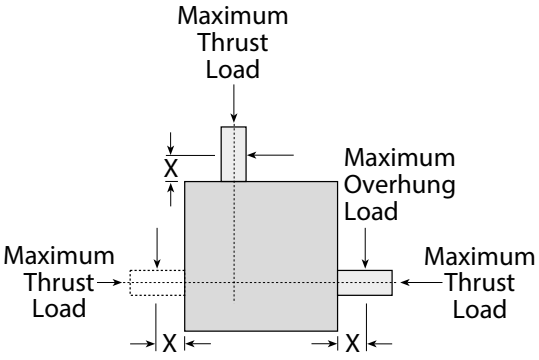
Part Number	Output Shaft Distance 'X'mm	Overhung Load kg	Thrust Load kg	Input Overhung Load kg
FF10	8	10	10	6
FF15	10	20	20	12
FF20	15	40	30	16
FF30	20	60	40	20
FF40	30	80	50	30
FF50	40	100	60	40

PRECISION GEARBOXES

Thrust Loads

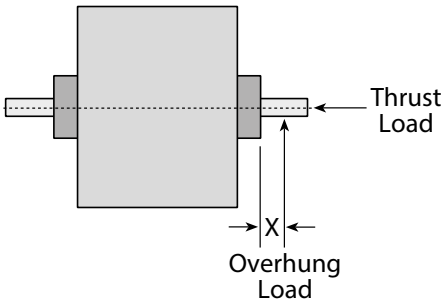
The following tables are based on an input speed of 1,000 rpm taking full load torque plus overhung load and thrust load:-

BLH BLHT TYPE
Bevel Gearboxes



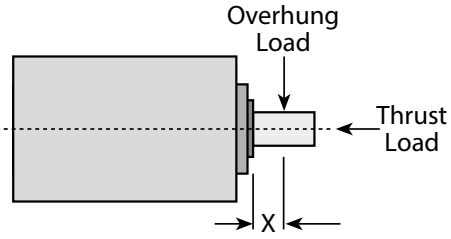
Part Number	Output Shaft Distance 'X'mm	Output Shaft Overhung Load kg	Output Shaft Thrust Load kg
BLH/BHT20	6	4	3
BLH/BHT30	10	8	6
BLH/BHT40	12	12	10
BLH/BHT50	20	20	15
BLH/BHT60	25	30	25
BLH/BHT70	-	-	-

J XJ NT NH TYPE
Spur Planetary Gearboxes



Part Number	Output Shaft Distance 'X'mm	Output Shaft Overhung Load kg	Output Shaft Thrust Load kg
J/XJ51-52-53	6	5	5
J/XJ64-65-66	6	5	5
NH/NT61-62-63	10	12	10
NH/NT91-92	15	20	15
NH/NT121-122	20	25	20

EHD TYPE
Epicyclic Gearboxes



Part Number	Output Shaft Distance 'X'mm	Output Shaft Overhung Load kg	Output Shaft Thrust Load kg
EHD04*	10	20	15
EHD06*	10	25	15
EHD08*	12	30	20
EHD12‡	20	60	60
EHD16‡	30	100	100

* Ball bearings
‡ Taper roller bearings

TECHNICAL