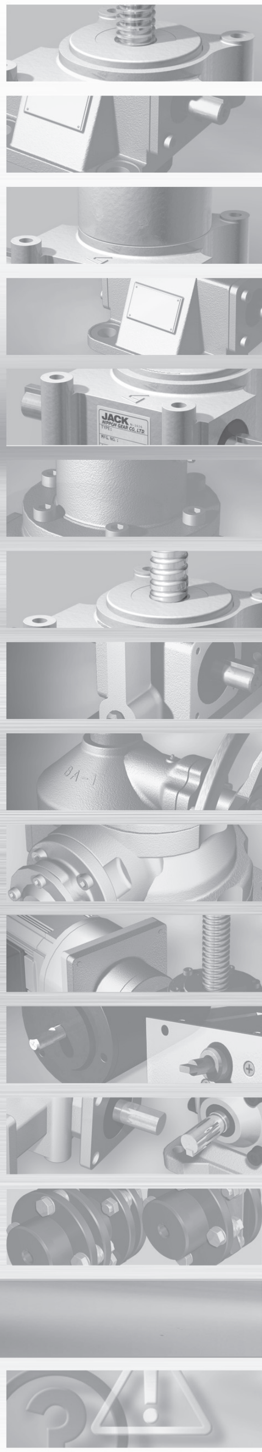
Technical Data

15



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Standard Specifications

Accuracy of lifting screw (at the time of delivery)

Trapezoidal screw

- Material: S45C
- Backlash

(mm)

RMG	RSG	J0G	J1G	J2G	J3G	JGA	J4A	J5A	J6A	JFA	J7A
≦0.1	≦0.1	≦0.1	≦0.2	≦0.3	≦0.3	≦0.3	≦0.6	≦0.6	≦0.6	≦0.6	≦0.6

Values of backlash are measured at the time of delivery. The values increase with the use of the jacks.

- Accumulated lead error: ±0.2/300 mm or less

Ball screw (JIS C10 class)

- Backlash: 0.3 mm or less
- Accumulated lead error: ±0.2/300 mm or less

Material for dustproof bellows

- Chloroprene rubber cloth

Grease

- Nippeco S No. 2 (supplied by Nippeco Ltd.)
- Grease nipple straight type 1/8 inch

Paint

- Phthalic acid series Munsell 10BG6/4
- Jacks with aluminum housing not painted

Special Specifications

The following specifications are illustrative examples. For other special specifications, please consult with us, as we can manufacture what you need.

Trapezoidal screw

- Material: SUS304 (maximum load capacity is 1/2 of standard type)
  SUS420 (maximum load capacity is the same, but antirust effect is lower than that of SUS304)
- Various shaft end processing
- Low-temperature black chromium finishing

Ball screw

- Accuracy: C7 class, C5 class
- Various shaft end processing
- Low-temperature black chromium finishing

Input shaft

- One side protection cover
- One side cut
- Hard chrome plating
- Low-temperature black chromium finishing

End fitting device

- Material: SUS304 (maximum load capacity is 1/2 of standard type)
  SUS420 (maximum load capacity is the same, but antirust effect is lower than that of SUS304)
- Low-temperature black chromium finishing

Dustproof bellows

- Silicon bellows (-40～150℃)
- Glass cloth bellows (-20～250℃)

Paint

- Various paint colors
- Epoxy paint
- Polyurethane paint
- Heat-resistant paint

Lifting screw cover

- Material: SUS304

Grease

- Heat-resistant grease
- Low-dust emission grease

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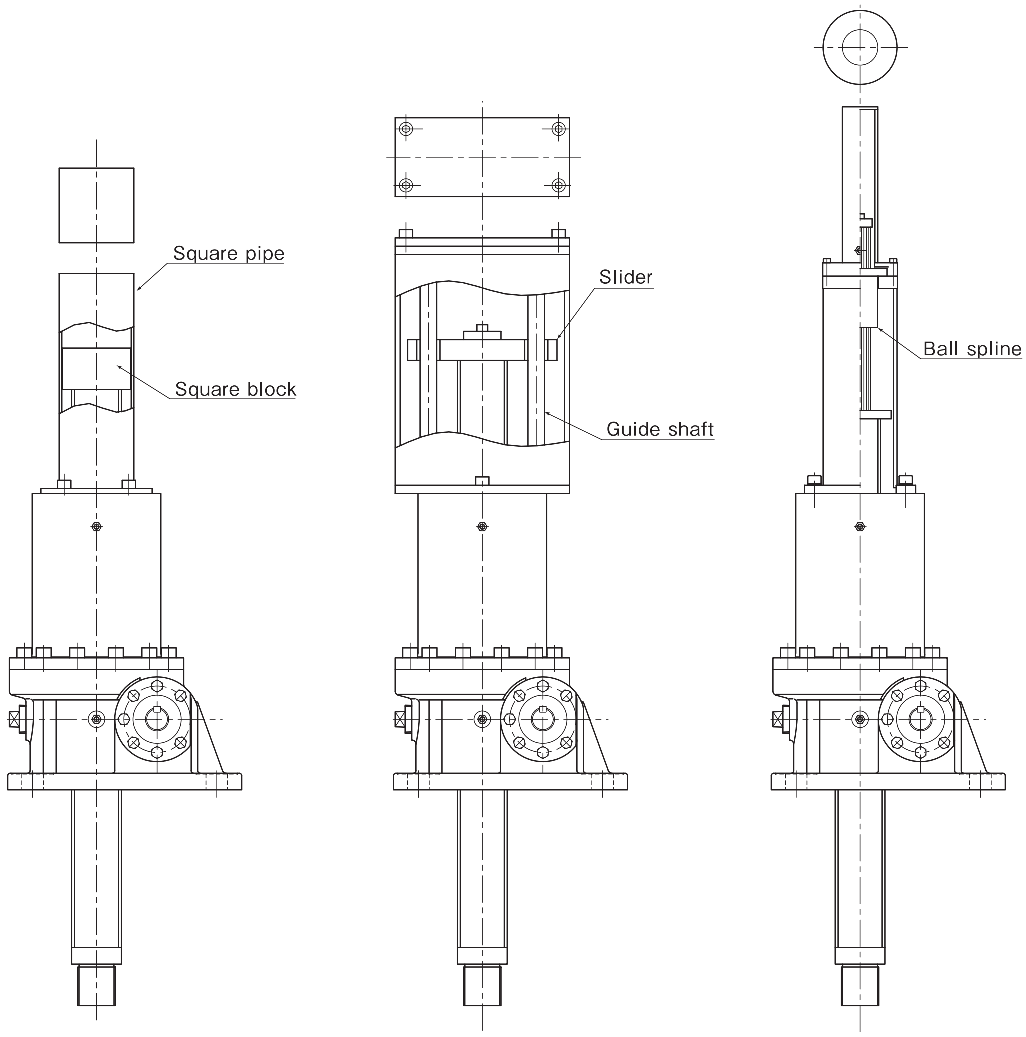
Examples of Manufacturing of Special Type Jacks

Nippon Gear will manufacture special type jacks according to your particular needs.
Please consult us when you consider a special type.

Ball screw jack with anti-rotation mechanism

- This jack has an anti-rotation mechanism at the ball screw end, and is used in case an anti-rotation mechanism cannot be secured at the side of your device.
- Different types should be used depending on the accuracy of a backlash amount of the rotation stopper and the frequency of use of the jack.

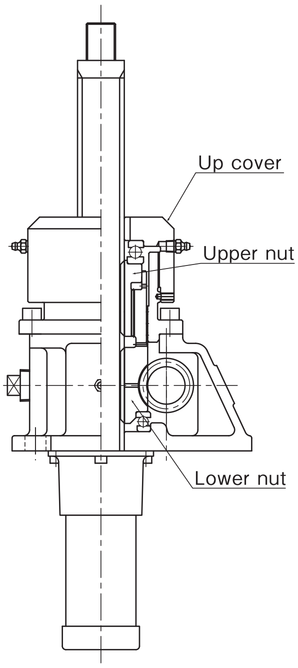


· Square pipe type · For low frequency of use · Accuracy: low · Compact	· Slider type · For medium frequency of use · Accuracy: medium · Lifting screw cover is expanded in horizontal direction	· Ball spline type · For high frequency of use · Accuracy: high · Lifting screw cover is expanded in vertical direction

Anti-backlash jack (trapezoidal screw type)

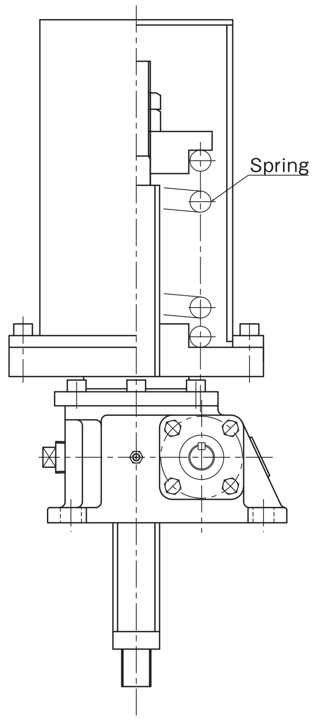
Double-nut method

It adjusts the backlash of the trapezoidal screw to be 0.05 mm or less by tightening the upper and lower nuts with the up cover. (Under this method, the jack does not operate when the backlash is zero)
If the trapezoidal screw becomes worn, the amount of backlash will increase, so it should be controlled by adjusting the up cover.



Spring method

By supporting the screw with a coil spring whose force is larger than the load, the backlash of the trapezoidal screw is eliminated to zero.
The input torque of the jack becomes greater corresponding to the force of the spring.



* In case of a ball screw jack, the backlash can be reduced by selecting a higher precision class ball screw.

Clean type

Hi-speed ball screw jack

Long-life ball screw jack

Low-noise ball screw jack

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Selection Procedure

To select a jack series/size code, calculate lifting load, lifting screw speed, buckling load, and operating frequency, and then check with the applicable specification table of each series/size code.

Step 1

If you need manual operation or a self-locking function, make an initial selection from the following series/size codes with the self-locking function.

R*G、J*G、J*A、BA*

If you do not need a self-locking function, go to step 2.

Note: There may be cases where the self-locking function does not work due to vibration, impact, or adaptation.
Installation of a break may be required to fully ensure the position of a jack.

Step 2

Calculate required input torque.
Make an initial selection of a series/size code based on the lifting load.

T=aW+b	T	：	Required input torque N·m
	a	：	Torque coefficient (refer to the applicable specification table)
	b	：	Torque with no load N·m (refer to the applicable specification table)
	W	：	Lifting load kN

Lifting load should not exceed the maximum load capacity.
Lifting load is the force acting on a jack. Select your model, taking into account safety issues concerning unbalanced load, sliding resistance of the guide, etc.

In case of manual operation, calculate handle operation force based on the required input torque and handle diameter.
We recommend that you should ensure the handle operation force is no more than 50N.

Handle operation force(N)＝Required input torque(N･m)／Handle diameter(m)

Step 3

Calculate input rotation speed based on lifting screw speed.
If you already know input rotation speed, go to step 4.

n=V/c	n	: Input rotation speed min^{-1}
	V	: Lifting screw speed mm/min
	c	: Speed coefficient (refer to the applicable specification table)

Input rotation speed should not exceed maximum allowable input rotation speed stated in the applicable specification table.

Reference **Relationship between lifting screw speed and input rotation speed**

$$\text{Input rotation speed} (min^{-1}) = \frac{\text{Lifting screw speed (mm/min)} \times \text{worm gear ratio}}{\text{Lifting screw lead (mm)}}$$

$$\text{Output rotation speed} (min^{-1}) = \frac{\text{Lifting screw speed (mm/min)}}{\text{Lifting screw lead (mm)}}$$

- Lifting screw lead: traveling distance of lifting screw in the axial direction per one rotation of the worm wheel
- Worm gear ratio: amount of input shaft rotation necessary for one rotation of the worm wheel

In case of manual operation, calculate how many revolutions of the handle are required for one stroke.

Number of revolutions of handle per stroke = Stroke / Speed coefficient

Step 4

Calculate required power.

P=(n×T)/9550	P	: Required power kW
	n	: Input rotation speed min^{-1}
	T	: Required input torque N•m

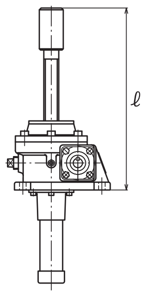
Required power should not exceed maximum allowable power in the applicable specification table.
In selecting a motor, ensure to select a model which satisfies the calculated values of both the required input torque and required power.

Step 5

In case compressive load is to be applied, consider allowable buckling load.
In case only tension load is to be applied, this consideration is not necessary.

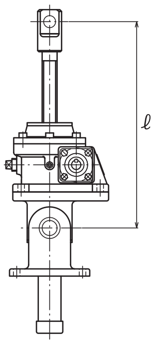
Jack fixed / shaft end free

n＝1／4



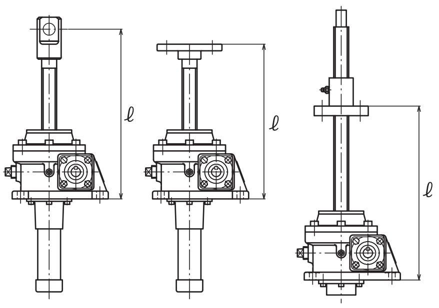
Jack supported / shaft end supported

n＝1



Jack fixed / shaft end supported

n＝2



$$P_{cr}=n\pi^2E(k/\ell)^2\cdot A\cdot\alpha \quad (N)$$

n : Shaft end support coefficient
- Jack fixed / shaft end free: n=1/4
- Jack supported / shaft end supported: n=1
- Jack fixed / shaft end supported: n=2

E : Longitudinal elastic modulus — $2.1\times10^5 N/mm^2$

d_1 : Minor diameter of screw

RMG	: 12.5 (mm)	RSB	: 13.5
RSG	: 16	J0B	: 17.5
J0G	: 16	J1B	: 21.4
J1G	: 20	J2B	: 31.2
J2G	: 32	J3B	: 39.6
J3G	: 39.5	J4B	: 53
JGA	: 44.5	J5B	: 70.5
J4A	: 50.5	J6B	: 88.3
J5A	: 68	JFB	: 106.4
J6A	: 101	J7B	: 123.7
JFA	: 115	RSF	: 13.7
J7A	: 129	J0F, JSH	: 17.5
		J1F, J0H	: 21.9
		J2F, J1H	: 31.8
		J3F, J2H	: 34.3
		J4F	: 43.5

k : Minimum secondary radius $k=\frac{d_1}{4}$

ℓ : Shaft support length mm

A : Cross-sectional area of lifting screw $A=\frac{\pi(d_1)^2}{4}$

α : Safety coefficient $\alpha=0.25$

＊Please contact us for the buckling calculations for RSB series.

Step 6

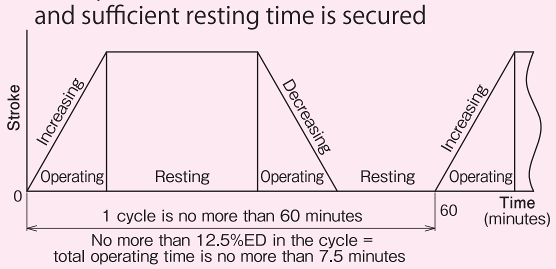
Calculate percentage duty cycle (%ED).

Jacks are to be used for intermittent operation only, and cannot be used for continuous operation.
Operate a jack within an allowable range of percentage duty cycle, while setting 60 minutes as a unit time.

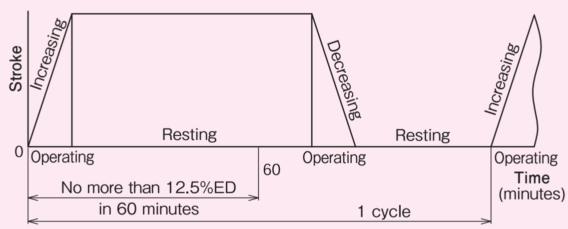
$$\%ED = \frac{\text{operating time per cycle}}{\text{operating time per cycle} + \text{resting time per cycle}} \times 100\,(\%)$$

● Example of ensuring the percentage duty cycle does not exceed 12.5%ED in a 60-minute unit time.

1. One cycle is no more than 60 minutes, and sufficient resting time is secured

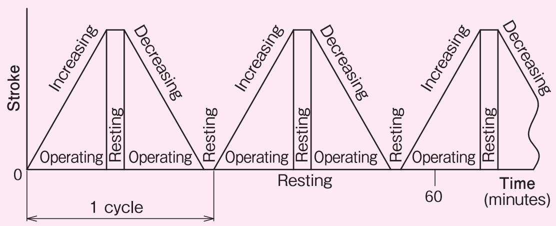


2. One cycle exceeds 60 minutes, but percentage duty cycle in 60 minutes does not exceed 12.5%ED

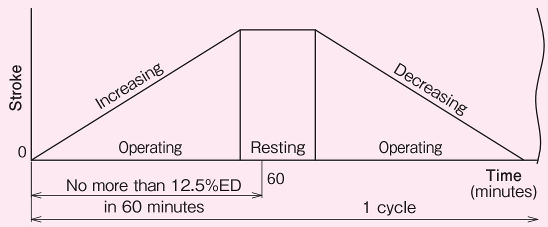


● In case of following examples, you need to reconsider your operating pattern.

1. Although one cycle is no more than 60 minutes, resting time is short, and percentage duty cycle exceeds 12.5%ED



2. One cycle exceeds 60 minutes, and percentage duty cycle exceeds 12.5%ED



● Allowable percentage duty cycle

J*H	:	No more than 70%ED, and the number of start-ups per minute is no more than 20 times
R*G、B、Y、F	:	No more than 25%ED
Other series	:	No more than 12.5%ED

Step 7

Other matters to be checked

- In case of translating jacks under R*G, J*G, and J*A series, confirm whether side force is within the allowable range of side force stated in the applicable allowable side force table.
  As for other jacks, side force cannot be applied, so install a guide.
- In case overhung load acts on input shaft, confirm whether such load is within the allowable range stated in the applicable specification table.

Example of Selection

Example

Operating conditions: Lifting load 30kN (compressive load) Lifting speed 1000 mm/min
Operating frequency: 1 reciprocation / time x 8 hours/day x 250 days/year; Self-locking needed; Stroke 200 mm; Upright; with Clevis; with bellows; without anti-rotation key

Step 1

Based on the necessity for a self-locking function and lifting load, tentatively select J2G with worm gear ratio “H”.

Step 2

・Calculation of input torque

$a=0.99 \quad b=2$

$T=aW+b=0.99\times30+2=31.7\text{N·m}$

Step 3

・Calculation of input rotation speed

$c=1.33$

$$n=\frac{V}{c}=\frac{1000}{1.33}=759.1\ \text{min}^{-1}$$

Step 4

・Calculation of required power

$$P=\frac{n\times T}{9550}=\frac{759.1\times31.7}{9550}=2.5\text{kW}>2.3\text{kW}$$ Maximum allowable power of J2GH

As the calculated result exceeds the maximum allowable power, J2GH does not match the requirements. So select an upper series J3GH, and calculate required power again.

$a=0.97 \quad b=3 \quad c=1.25$

$T=aW+b=0.97\times30+3=32.1\text{N·m}$

$$n=\frac{V}{c}=\frac{1000}{1.25}=800\ \text{min}^{-1}$$

$$P=\frac{n\times T}{9550}=\frac{800\times32.1}{9550}=2.7\text{kW}<3.1\text{kW}$$ Maximum allowable power of J3GH

As the calculated result is less than the maximum allowable power of J3GH, there is no problem with selecting J3GH.

Step 5

・Calculation of buckling load

According to the measurement table, in case of J3GH for stroke 200, upright type, without dustproof bellows, and with anti-rotation key, the max length is 385.
Furthermore, the distance to clevis hole is 48.

ℓ =385+48=433mm n=2 d1=39.5mm

Pcr=nπ2E(k/ℓ)2•A•α=660.5 >30kN Lifting load

As allowable buckling load is greater than lifting load,
there is no problem with selecting this model.
Although calculated Pcr value may exceed maximum lifting capacity,
a jack can be used for load only up to the maximum lifting capacity.

Step 6

・Calculation of percentage duty cycle (%ED)

When lifting screw speed is 1000 mm/min, time required for one reciprocation of 400 mm is

400/1000=0.4 min

Based on one reciprocation / time, 1 cycle = 1 hour (60 min)

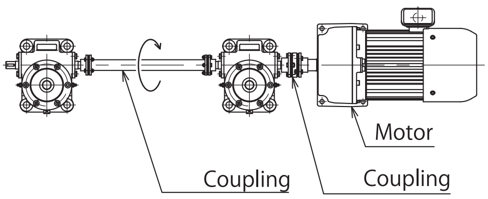
%ED=0.4/60×100=0.7%ED < 12.5%ED Allowable %ED

As %ED is within the allowable range, there is no problem with selecting this model.

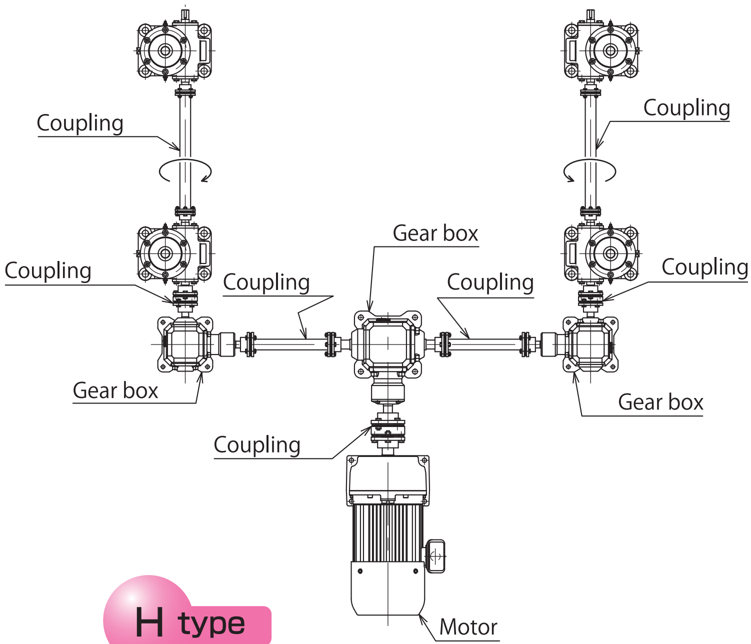
Jack System

Screw jacks, ball screw jacks, and rack jacks are linear actuators which can easily realize accurate interlocking, and are best for synchronized operation of multiple jacks.
We also offer gear boxes and couplings, so please consider a jack system by combining them.

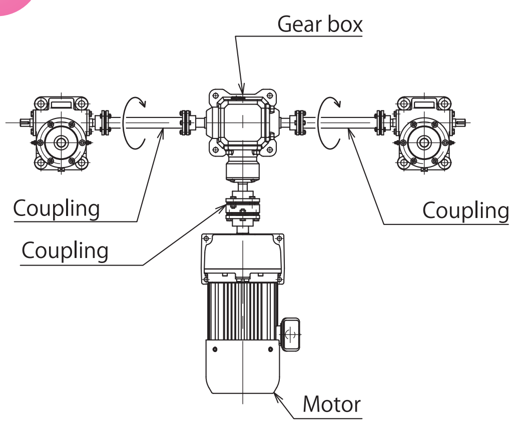
I type



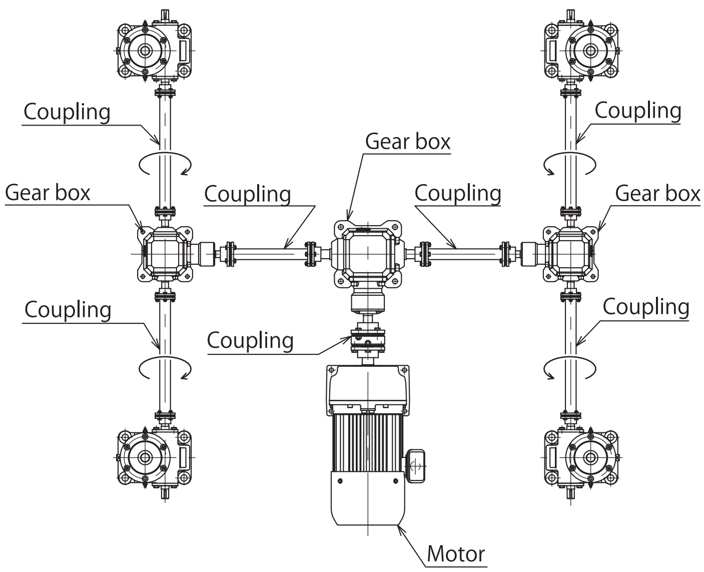
U type



T type



H type



Names of system types shown above come from the configurations of connecting shafts, which look like respective English capital letters. When the input shaft rotates in the direction indicated by an arrow in the above drawings, the lifting screw ascends.

Selection of Jack System

Step 1

According to the Jack Selection Procedure, calculate required input torque per jack and required power per jack.

Step 2

・Calculate total required input torque.

$$\Sigma T = \frac{T \cdot Z}{\eta_D \cdot \eta_G^n}$$

T : required input torque per jack N・m
Z : number of jacks used
η_D : interlocking efficiency
2 jacks: 0.95　3 jacks: 0.9
4 jacks: 0.85　5 or more jacks: 0.8
η_G : Gear box efficiency 0.95
n : number of gear boxes used

Step 3

・Calculate total required power.

$$\Sigma P = \frac{P \cdot Z}{\eta_D \cdot \eta_G^n \cdot \eta_M}$$

η_M : Geared motor (speed reducer) efficiency　0.9

In selecting a motor, ensure to select a motor which satisfies the calculated values of both the total required input torque and total required power.

As for allowable torque of input shaft, when the input shafts are connected in a series, the allowable input shaft torque is shown in the following table:

RMG	40N·m
JMR	50
JSR	145
RSG、RSB	50
J0G、J0B、J0F	50
J1G、J1B、J1F	50
J2G、J2B、J2F	145

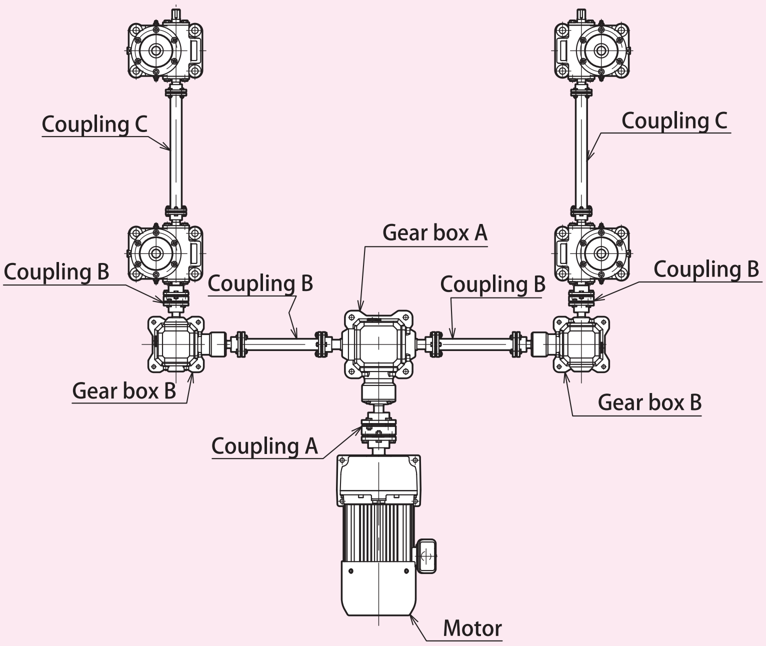
J3G、J3B、	272N·m
J3F	272
JGA	272
J4A、J4B	407
J4F	834
J5A、J5B	1106
J6A、J6B	1954
JFA、JFB	1954

Example of Selection

Example

J2GH

Load per jack 25kN
Lifting speed 300 mm/min
System layout: U type



Step 1

Required input torque and required power per jack

T=26.75N･m　n=225min-1　P=0.63kW

Step 2

・Total required input torque A

Calculate the total torque of the entire jack system

$$\Sigma T=\frac{T \cdot Z}{\eta^{D} \cdot \eta_{G}^{n}}=\frac{26.75\times 4}{0.85\times 0.95^{3}}=146.8\text{N·m}$$

・Total required input torque B

Calculate the torque of 2 jacks on the edges of the system

$$\Sigma T=\frac{T \cdot Z}{\eta^{D} \cdot \eta_{G}^{n}}=\frac{26.75\times 2}{0.95\times 0.95}=59.3\text{N·m}$$

Step 3

・Total required power A

Calculate the power of the entire jack system

$$\Sigma P = \frac{P \cdot Z}{\eta^{D} \cdot \eta^{n}_{G} \cdot \eta^{M}} = \frac{0.63 \times 4}{0.85 \times 0.95^{3} \times 0.95} = 3.6\text{kW}$$

・Total required power B

Calculate the power of 2 jacks on the edges of the system

$$\Sigma P = \frac{P \cdot Z}{\eta^{D} \cdot \eta^{n}_{G} \cdot \eta^{M}} = \frac{0.63 \times 2}{0.95 \times 0.95} = 1.4\text{kW}$$

- Select the motor and gear box A which satisfy the calculated values of both the total required input torque and total required power A.
- Select coupling A which satisfies the calculated value of the total required input torque A.
- Confirm that the calculated value of the total required input torque B does not exceed the allowable input torque at the time of interlocked operation (see the table on P221).
- Select gear box B which satisfies the calculated values of both the total required input torque B and total required power B.
- Select coupling B which satisfies the calculated value of the total required input torque B.
- Select coupling C which satisfies the torque T value.