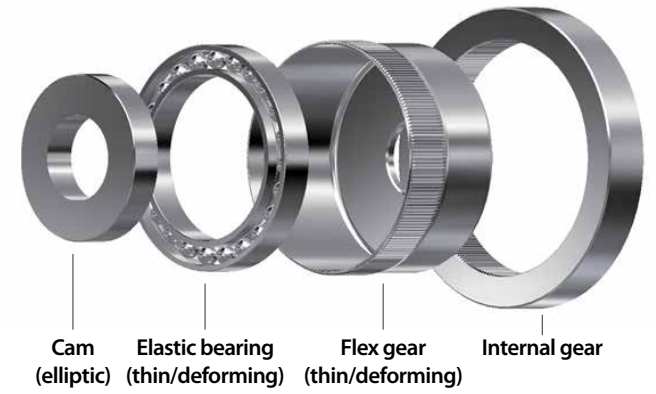
- *Near Zero backlash*
- *High efficiency ratings*
- *High reduction ratios in a compact footprint*
- *Exceptional repeatability and torsional stiffness*
- *Extremely light weight with superior torque density*

These characteristics enable the **FLEXWAVE** to be the superior choice when sizing and selecting the proper reduction technology for **ROBOTICS, MEDICAL EQUIPMENT, SEMICONDUCTOR and CIRCUIT MANUFACTURING, MACHINE TOOLS** or any **ASSEMBLY AUTOMATION** applications requiring fine positioning.

## An Exposé on Strain Wave Gear Technology

### Reduction Mechanism

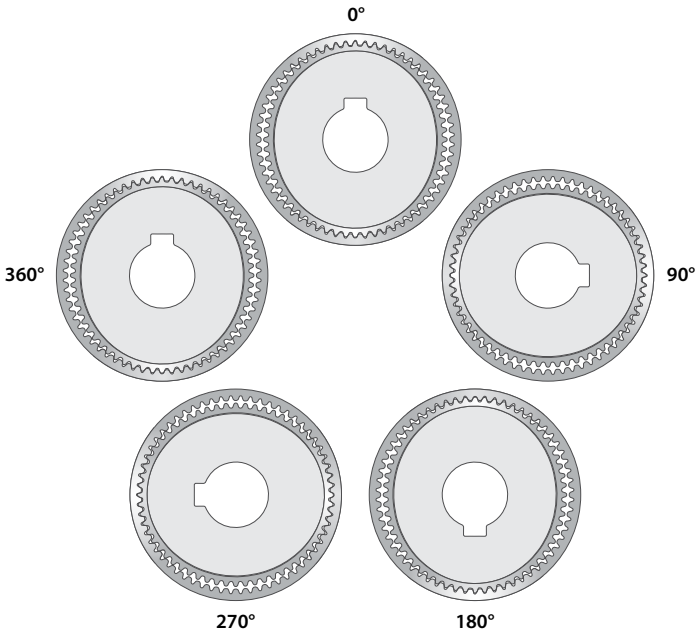
Strain wave gear technology centers on the elasticity and flexibility properties of a uniquely shaped metal structure. The strain wave gear set has three key elements; the elliptical wave generator subassembly, the flexible cup gear, and the innerr ring gear.




- *The elliptical wave generator subassembly is comprised of two components: an elliptical shaped disk and an outer ball bearing. The disk is inserted into the bearing, giving the bearing an elliptical shape as well. The wave generator assembly is the input section of the gear set.*
- *The flexible cup gear is the internal component that relies on unique elasticity properties to accommodate an elliptical deformation pattern. The sides of the cup gear are very thin, but the bottom of the cup gear is thick and rigid. This results in significant flexibility of the walls at the open end of the cup; but then the cup gear exhibits high rigidity at the closed end of the cup. Teeth are positioned radially around the perimeter of the open end of this cup gear.*
- *The flexible cup gear fits very tightly over the wave generator subassembly. When the wave generator is rotated, the cup gear deforms to the shape of a rotating ellipse but does not rotate with the wave generator.*
- *The inner ring gear is a rigid circular ring with teeth located on the interior perimeter. The wave generator and cup gear are placed inside this inner ring gear, meshing the teeth together. Because the cup gear has a deformed elliptical shape, the teeth will only mesh in two regions 180 degrees from each other, along the axis of the ellipse.*
- *As the wave generator subassembly rotates, the group of teeth of the cup gear that are engaged with those of the inner ring gear changes. The major axis of the cup gear actually rotates with the wave generator therefore; the points where the teeth mesh revolve around the center point at the same rate as the wave generator.*
- *The reduction is accomplished through a tooth count differential between the cup gear and the inner ring gear. For every full rotation of the wave generator subassembly, the cup gear rotates a minor amount backward because it has less teeth than the inner ring gear.*

### Reduction Ratio

The rotation the wave generator subassembly results in a much slower rotation of the cup gear in the opposite direction. For a strain wave gearing mechanism, the gearing reduction ratio can be calculated from the number of teeth on each gear:

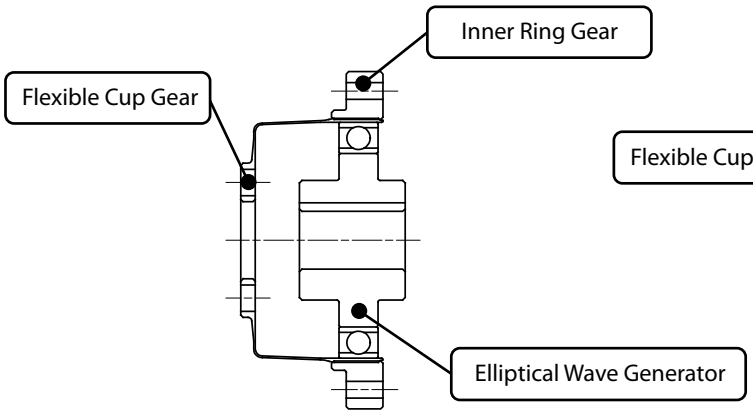


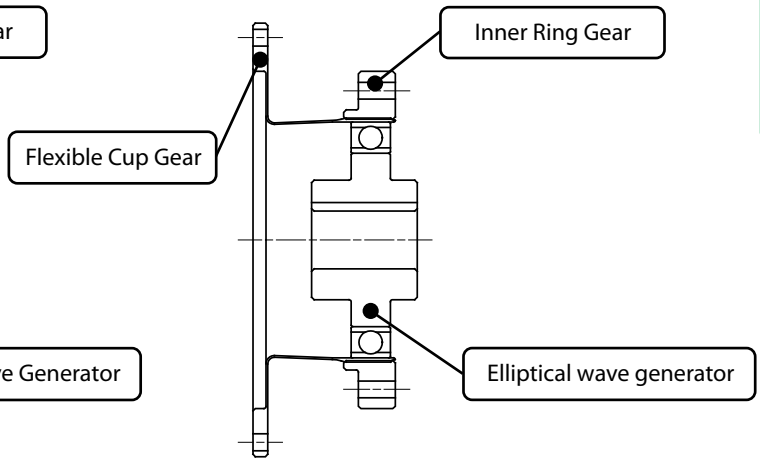

As an example, if there are 202 teeth on the inner ring gear and 200 on the cup gear, the reduction ratio is

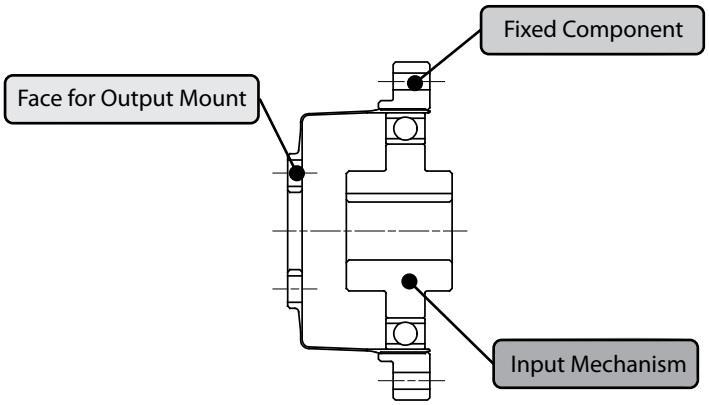
$(200 - 202)/200 = -0.01$

Therefore the cup rotates at 1/100 of the speed of the wave generator assembly and in the opposite direction. This method of reduction permits a variety of ratios to be set without changing overall gear set shape, increasing its weight, or adding reduction stages. The variety of reduction ratios possible is restricted by the structural tooth size limitation for any given configuration.

## Component Level Detail and Reduction Ratio

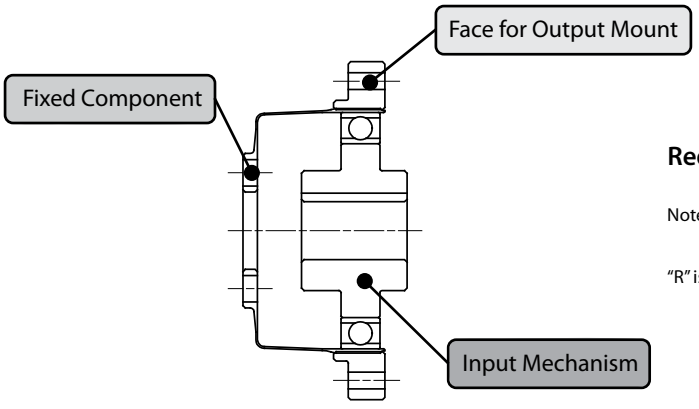



**Reduction ratio** $= \frac{-1}{R}$

Note: The input and output rotation directions are opposite

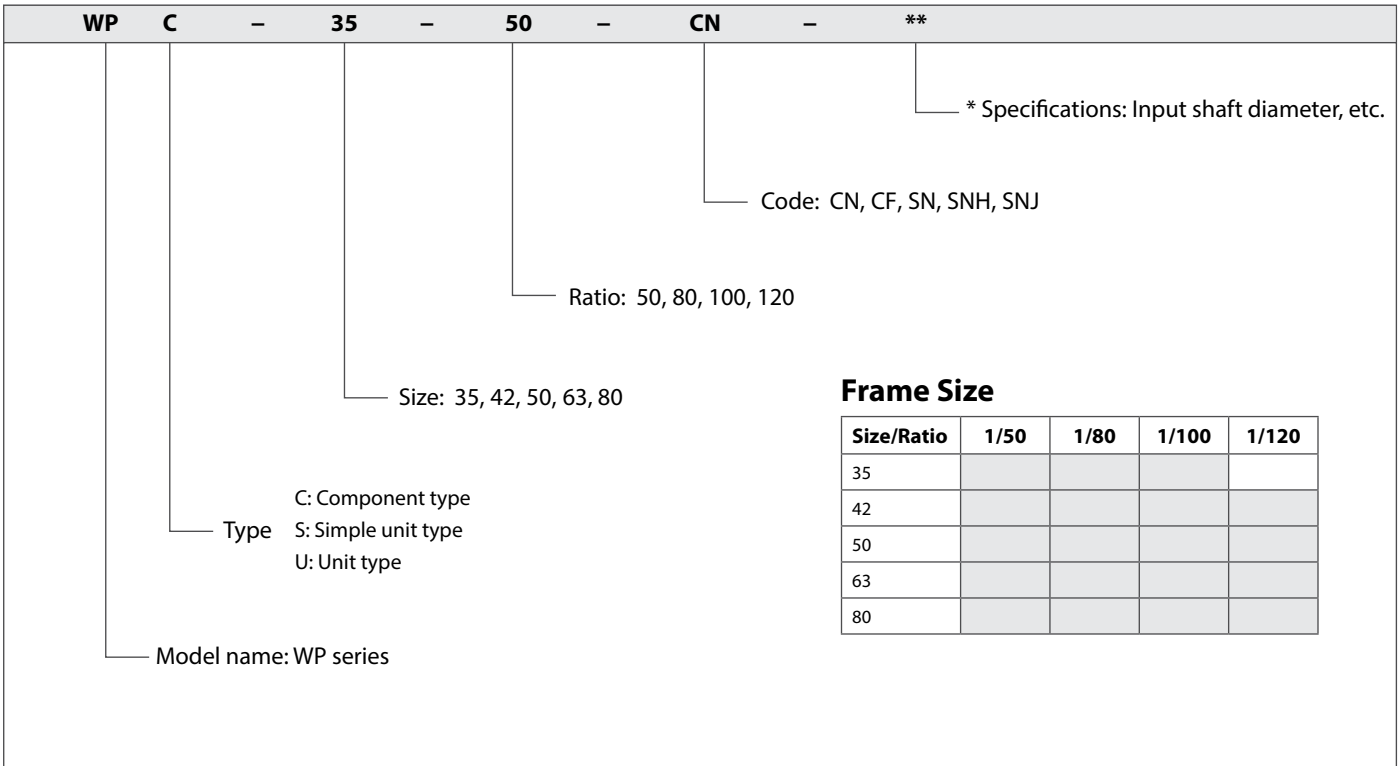



**Reduction ratio** $= \frac{1}{R+1}$

Note: The input and output rotation directions are same

"R" is the ratio. Please refer to "Reducer Specifications" in the next page

## Model Code and Basic Performance Specifications




### Frame Size

| Size/Ratio | 1/50 | 1/80 | 1/100 | 1/120 |
|---|---|---|---|---|
| 35 | | | | |
| 42 | | | | |
| 50 | | | | |
| 63 | | | | |
| 80 | | | | |

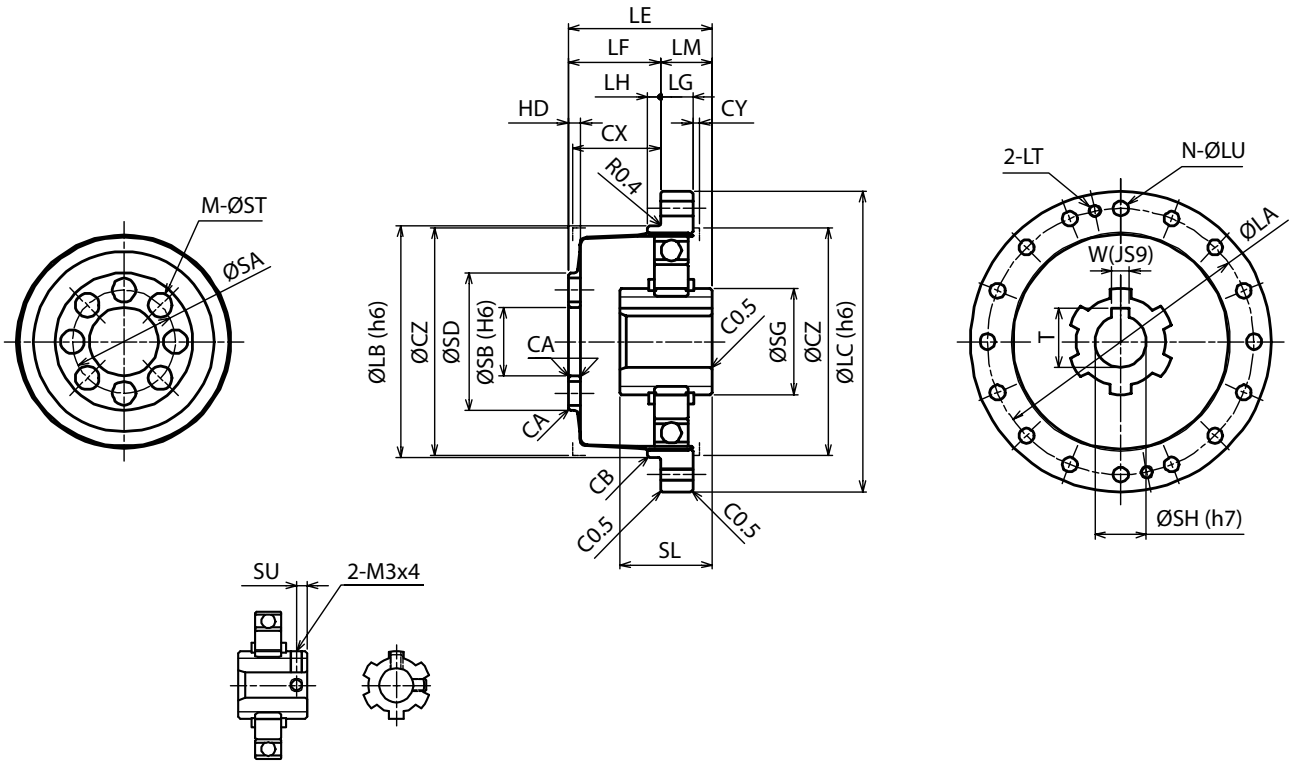
## Reducer Specifications

| Size | Ratio | Nominal Output Torque *1 | Maximum Output Torque *2 | Emergency Stop Torque *3 | Nominal Input Speed *4 | Maximum Input Speed *5 | Permitted Axial Load *6 |
|---|---|---|---|---|---|---|---|
| | | Nm | Nm | Nm | r/min | r/min | ×10-4kgm2 |
| 35 | 50 | 7 | 23 | 46 | 3000 | 8500 | 0.027 |
| | 80 | 9 | 27 | 55 | | | |
| | 100 | 9 | 32 | 63 | | | |
| 42 | 50 | 21 | 44 | 91 | 3000 | 7300 | 0.055 |
| | 80 | 26 | 50 | 102 | | | |
| | 100 | 28 | 63 | 129 | | | |
| | 120 | 28 | 63 | 129 | | | |
| 50 | 50 | 33 | 73 | 127 | 3000 | 6500 | 0.158 |
| | 80 | 40 | 86 | 149 | | | |
| | 100 | 47 | 96 | 172 | | | |
| | 120 | 47 | 96 | 172 | | | |
| 63 | 50 | 51 | 127 | 242 | 3000 | 5600 | 0.385 |
| | 80 | 66 | 142 | 266 | | | |
| | 100 | 70 | 163 | 295 | | | |
| | 120 | 70 | 163 | 295 | | | |
| 80 | 50 | 89 | 253 | 447 | 3000 | 4800 | 1.03 |
| | 80 | 122 | 316 | 590 | | | |
| | 100 | 142 | 346 | 673 | | | |
| | 120 | 142 | 346 | 673 | | | |

*1) The maximum value allowable at the input rotation speed of 2000r/min
*2) The maximum torque when starting and stopping
*3) The maximum torque when it receives shock
*4) The maximum average input speed
*5) The maximum average input torque
*6) Values depend on the input shaft diameter, etc.

## Closed Style - Component Sub-assembly

**WPC-□-□-CN**
**WPC-□-□-CF**




INPUT SHAFT FOR 35 & 42

| Size | LA | LB | LC | N *1 | LU | LT | LE | LF | LG | LH | LM | SG | SH | SL | W |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 35 | 44 | 38 | 50 | 8 (6) | 3.5 | M3 | 28.5 | 17.5 | 6 | 2 | 11 | 15.8 | 6 | 18.5 | - |
| 42 | 54 | 48 | 60 | 16 (12) | 3.5 | M3 | 32.5 | 20 | 6.5 | 2.5 | 12.5 | 15.8 | 8 | 20.7 | - |
| 50 | 62 | 54 | 70 | 16 (12) | 3.5 | M3 | 33.5 | 21.5 | 7.5 | 3 | 12 | 24.8 | 12 | 21.5 | 4 |
| 63 | 75 | 67 | 85 | 16 (12) | 4.5 | M4 | 37 | 24 | 10 | 3 | 13 | 27.8 | 14 | 21.6 | 5 |
| 80 | 100 | 90 | 110 | 16 (12) | 5.5 | M5 | 44 | 28 | 14 | 3 | 16 | 27.8 | 14 | 23.6 | 5 |

| Size | T | SU | SA | SB | SD | M | ST | HD | CA | CB | CX | CY | CZ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 35 | - | 2.5 | 17 | 11 | 23.5 | 6 | 4.5 | 2.4 | C0.5 | C0.3 | 17 | 1 | 38 |
| 42 | - | 3 | 19 | 10 | 27 | 6 | 5.5 | 3 | C0.5 | C0.3 | 19 | 1 | 45 |
| 50 | 13.8 | - | 24 | 16 | 32 | 8 | 5.5 | 3 | C0.5 | C0.5 | 20.5 | 1.5 | 53 |
| 63 | 16.3 | - | 30 | 20 | 40 | 8 | 6.5 | 3 | C0.5 | C0.5 | 23 | 1.5 | 66 |
| 80 | 16.3 | - | 40 | 26 | 52 | 8 | 8.8 | 3.2 | C0.5 | C0.5 | 26.8 | 1.5 | 86 |

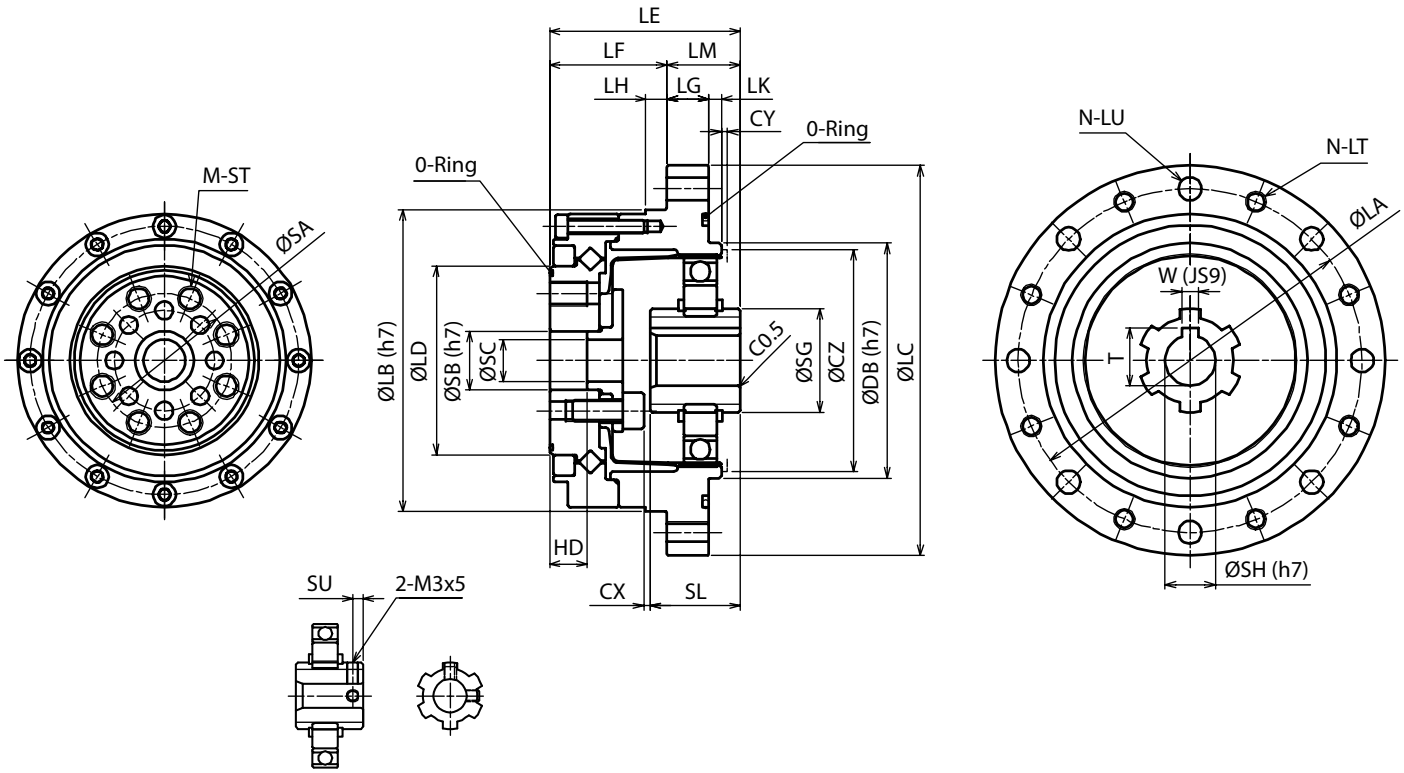
*1) -CN and -CF are different in dimensions. The -CF value is shown in parentheses

*2) For details in the input section, check the drawings

## Closed Style - Complete Unit Assembly

**WPU-□-□-CN**

**WPU-□-□-CF**




INPUT SHAFT FOR 35 & 42

| Size | LA | LB | LC | LD | N *1 | LT | LU | LE | LF | LG | LH | LK | LM | DB | SG |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 35 | 65 | 56 | 73 | 31 | 8 (6) | M4 | 4.5 | 41 | 27 | 7 | 3.5 | 2 | 14 | 38 | 15.8 |
| 42 | 71 | 63 | 79 | 38 | 8 (6) | M4 | 4.5 | 45 | 29 | 8 | 4 | 2 | 16 | 48 | 15.8 |
| 50 | 82 | 72 | 93 | 45 | 8 (6) | M5 | 5.5 | 45.5 | 28 | 10 | 5 | 3 | 17.5 | 56 | 24.8 |
| 63 | 96 | 86 | 107 | 58 | 10 (8) | M5 | 5.5 | 52 | 36 | 10 | 5 | 3 | 16 | 67 | 27.8 |
| 80 | 125 | 113 | 138 | 78 | 12 | M6 | 6.5 | 62 | 45 | 12 | 5 | 3 | 17 | 90 | 27.8 |

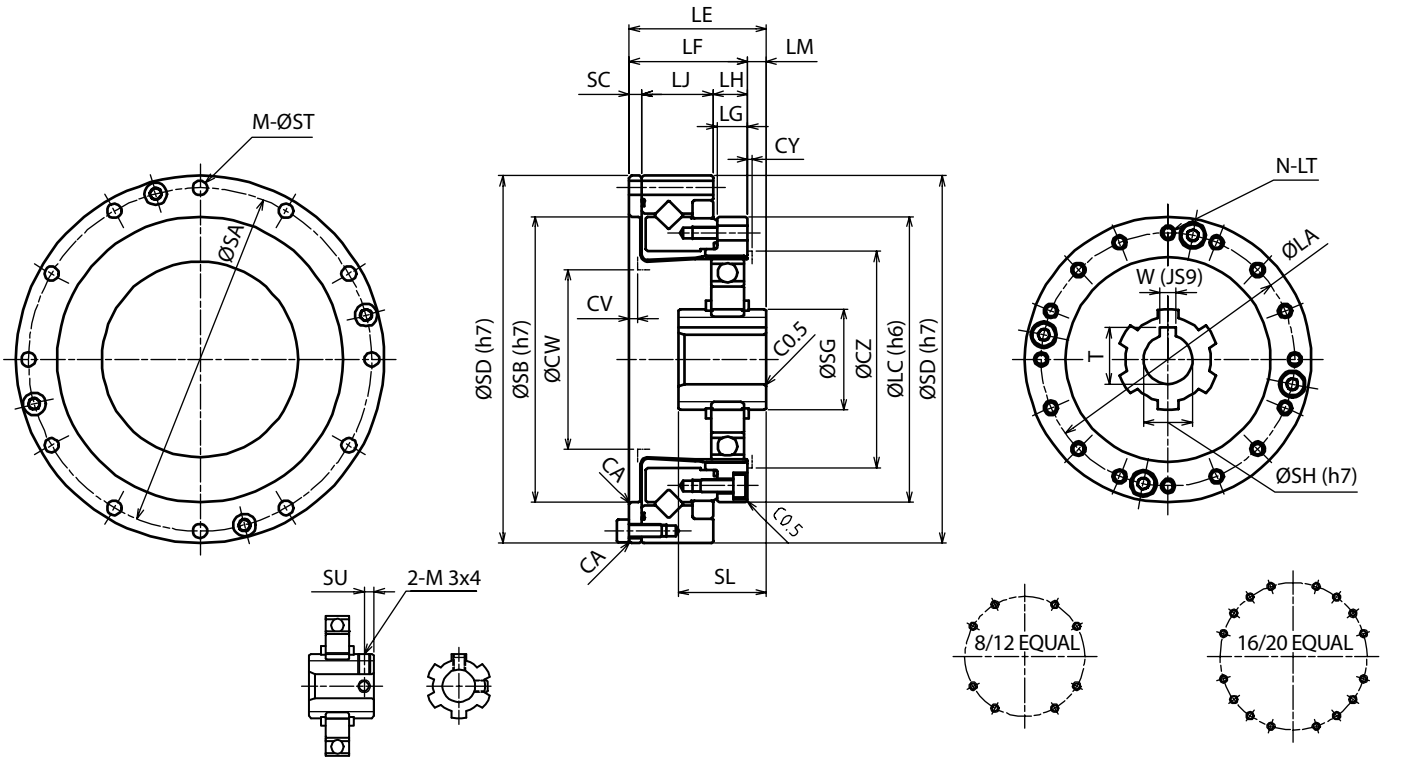
| Size | SH | SL | W | T | SU | SA | SB | SC | M | ST | HD | CX | CY | CZ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 35 | 6 | 18.5 | - | - | 2.5 | 23 | 11 | 8 | 6 | M4×8 | 9.5 | 1.6 | 1 | 38 |
| 42 | 8 | 20.7 | - | - | 3 | 27 | 10 | 7 | 6 | M5×8 | 9.5 | 1.3 | 1 | 45 |
| 50 | 12 | 21.5 | 4 | 13.8 | - | 32 | 14 | 10 | 8 | M6×9 | 9 | 1.5 | 1.5 | 53 |
| 63 | 14 | 21.6 | 5 | 16.3 | - | 42 | 20 | 15 | 8 | M8×10 | 12 | 3.4 | 1.5 | 66 |
| 80 | 14 | 23.6 | 5 | 16.3 | - | 55 | 26 | 20 | 8 | M10×12 | 15 | 5.2 | 1.5 | 86 |

*1) -CN and -CF are different in dimensions. The -CF value is shown in parentheses

*2) For details in the input section, check the drawings

## Open Style - Simple Contained Assembly

**WPS-□-□-SN**




IMPUT SHAFT FOR 35 & 42

"N-LT" ARRANGEMENT FOR 35

"N-LT" ARRANGEMENT FOR 42

| Size | LA | LC | LE | LF | LG | LH | LJ | LM |
|---|---|---|---|---|---|---|---|---|
| 35 | 44 | 50 | 28.5 | 23.5 | 6 | 7 | 14.1 | 5 |
| 42 | 54 | 60 | 32.5 | 26.5 | 6.5 | 8 | 16 | 6 |
| 50 | 62 | 70 | 33.5 | 29 | 7.5 | 8.5 | 17.5 | 4.5 |
| 63 | 77 | 85 | 37 | 34 | 10 | 12 | 18.7 | 3 |
| 80 | 100 | 110 | 44 | 42 | 14 | 15 | 23.4 | 2 |

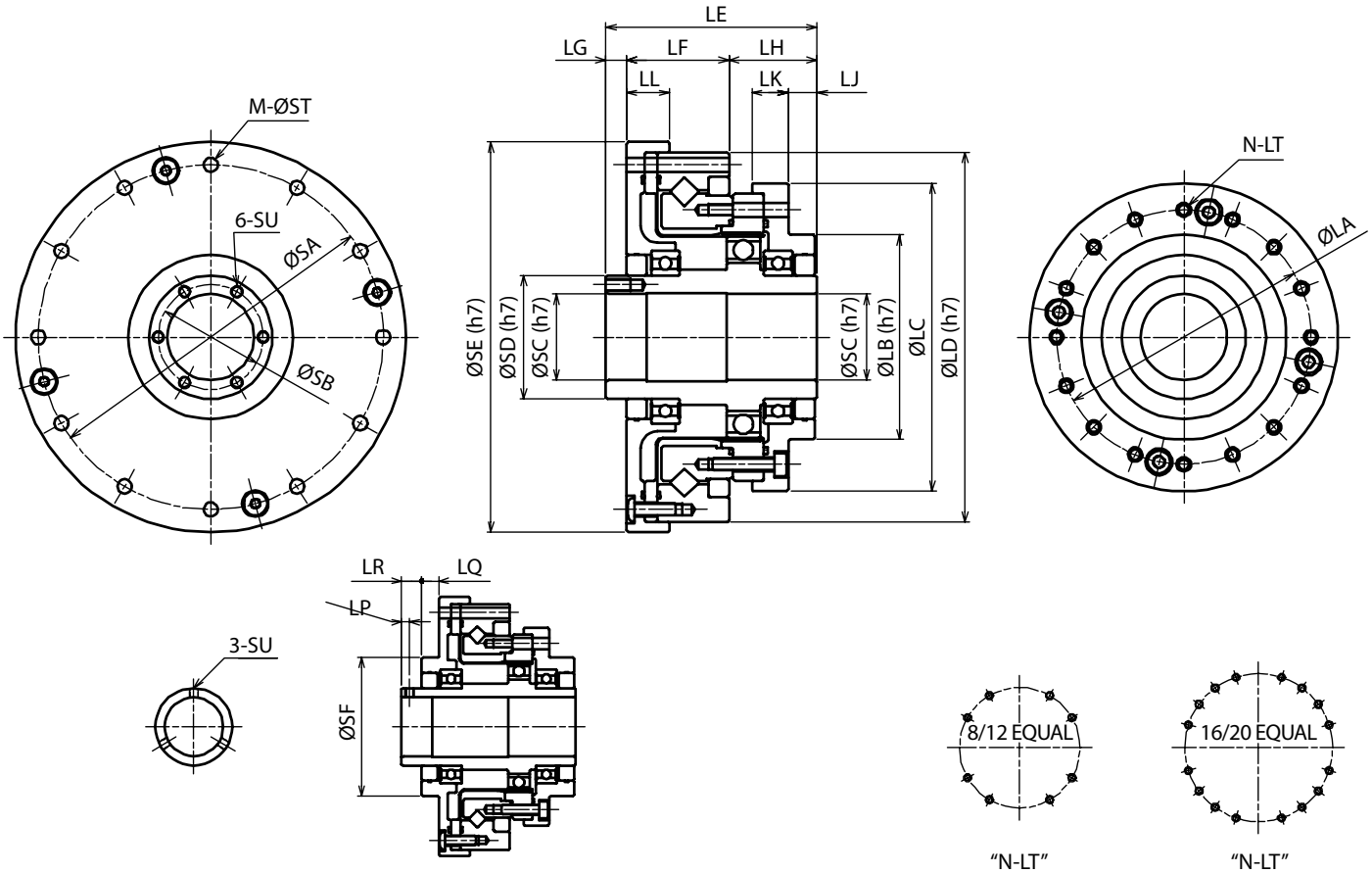
| Size | SG | SH | SL | W | T | SU | SA | SB |
|---|---|---|---|---|---|---|---|---|
| 35 | 15.8 | 6 | 18.5 | - | - | 2.5 | 64 | 48 |
| 42 | 15.8 | 8 | 20.7 | - | - | 3 | 74 | 60 |
| 50 | 24.8 | 12 | 21.5 | 4 | 13.8 | - | 84 | 70 |
| 63 | 27.8 | 14 | 21.6 | 5 | 16.3 | - | 102 | 88 |
| 80 | 27.8 | 14 | 23.6 | 5 | 16.3 | - | 132 | 114 |

| Size | SC | SD | M | ST | CA | CY | CZ | CV | CW | N | LT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 35 | 2.4 | 70 | 8 | 3.5 | C0.3 | 1 | 38 | 1.6 | 31 | 8 | M3×5, φ3.5×6 |
| 42 | 3 | 80 | 12 | 3.5 | C0.3 | 1 | 45 | 2 | 37 | 16 | M3×6, φ3.5×6.5 |
| 50 | 3 | 90 | 12 | 3.5 | C0.3 | 1.5 | 53 | 2 | 44 | 16 | M3×6, φ3.5×7.5 |
| 63 | 3.3 | 110 | 12 | 4.5 | C0.3 | 1.5 | 66 | 2 | 56 | 16 | M4×7, φ4.5×10 |
| 80 | 3.6 | 142 | 12 | 5.5 | C0.5 | 1.5 | 86 | 2 | 72 | 16 | M5×8, φ5.5×14 |

*1) For details in the input section, check the drawings

## Open Style - Complete Unit Assembly (Hollow shaft)

**WPU-□-□-SNH**




INPUT SHAFT FOR 35 & 42

"N-LT" ARRANGEMENT FOR 35

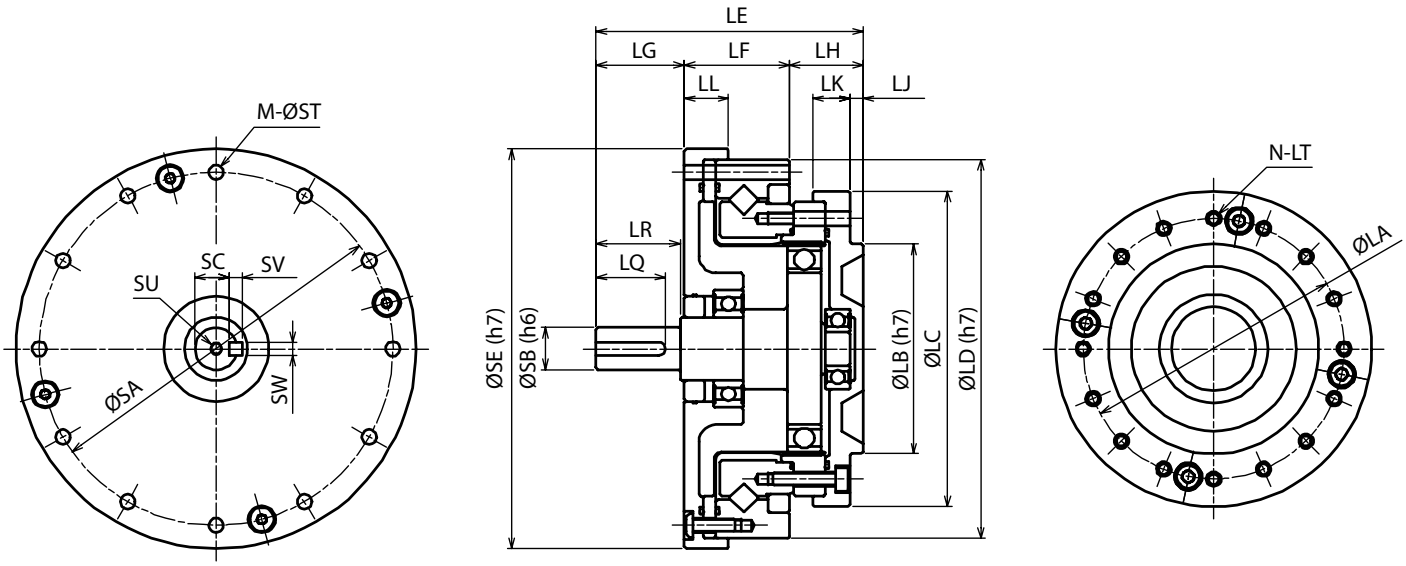
"N-LT" ARRANGEMENT FOR 42

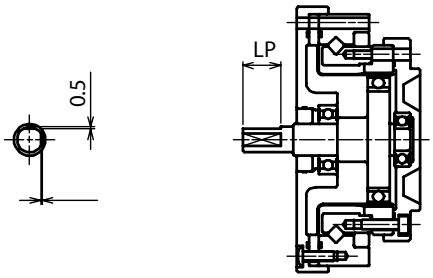
| Size | LA | LB | LC | LD | LE | LF | LG | LH | LJ | LK | LL | LP | LQ | LR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 35 | 44 | 36 | 54 | 70 | 52.5 | 20.5 | 12 | 20 | 7.5 | 8 | 9 | 2.5 | 5.5 | 6.5 |
| 42 | 54 | 45 | 64 | 80 | 56.5 | 23 | 12 | 21.5 | 8.5 | 8.5 | 10 | 2.5 | 5.5 | 6.5 |
| 50 | 62 | 50 | 75 | 90 | 51.5 | 25 | 5 | 21.5 | 7 | 9 | 10.5 | - | - | - |
| 63 | 77 | 60 | 90 | 110 | 55.5 | 26 | 6 | 23.5 | 6 | 8.5 | 10.5 | - | - | - |
| 80 | 100 | 85 | 115 | 142 | 65.5 | 32 | 7 | 26.5 | 5 | 9.5 | 12 | - | - | - |

| Size | SA | SB | SC | SD | SE | SF | M | ST | SU | N | LT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 35 | 64 | - | 14 | 20 | 74 | 36 | 8 | 3.5 | M3 | 8 | M3×5, φ3.5×11.5 |
| 42 | 74 | - | 19 | 25 | 84 | 45 | 12 | 3.5 | M3 | 16 | M3×6, φ3.5×12 |
| 50 | 84 | 25.5 | 21 | 30 | 95 | - | 12 | 3.5 | M3×6 | 16 | M3×6, φ3.5×13.5 |
| 63 | 102 | 33.5 | 29 | 38 | 115 | - | 12 | 4.5 | M3×6 | 16 | M4×7, φ4.5×15.5 |
| 80 | 132 | 40.5 | 36 | 45 | 147 | - | 12 | 5.5 | M3×6 | 16 | M5×8, φ5.5×20.5 |

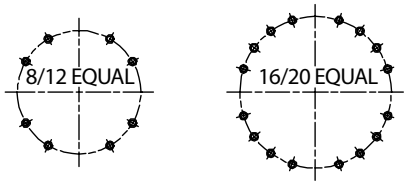
## Open Style - Complete Unit Assembly (Input shaft)

**WPU-□-□-SNJ**




INPUT SHAFT FOR 35 & 42




"N-LT" ARRANGEMENT FOR 35

"N-LT" ARRANGEMENT FOR 42

| Size | LA | LB | LC | LD | LE | LF | LG | LH | LJ | LK | LL | LP | LQ | LR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 35 | 44 | 36 | 54 | 70 | 50.5 | 20.5 | 15 | 15 | 2.5 | 8 | 9 | 11 | - | - |
| 42 | 54 | 45 | 64 | 80 | 56 | 23 | 17 | 16 | 3 | 8.5 | 10 | 12 | - | - |
| 50 | 62 | 50 | 75 | 90 | 63.5 | 25 | 21 | 17.5 | 3 | 9 | 10.5 | - | 16.5 | 20 |
| 63 | 77 | 60 | 90 | 110 | 72.5 | 26 | 26 | 20.5 | 3 | 8.5 | 10.5 | - | 22.5 | 25 |
| 80 | 100 | 85 | 115 | 142 | 84.5 | 32 | 26 | 26.5 | 5 | 9.5 | 12 | - | 22.5 | 25 |

| Size | SA | SB | SC | SE | SV | SW | M | ST | SU | N | LT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 35 | 64 | 6 | - | 74 | - | - | 8 | 3.5 | M3 | 8 | M3×5, φ3.5×11.5 |
| 42 | 74 | 8 | - | 84 | - | - | 12 | 3.5 | M3 | 16 | M3×6, φ3.5×12 |
| 50 | 84 | 10 | 8.2 | 95 | 3 | 3 | 12 | 3.5 | M3×6 | 16 | M3×6, φ3.5×13.5 |
| 63 | 102 | 14 | 11 | 115 | 5 | 5 | 12 | 4.5 | M3×6 | 16 | M4×7, φ4.5×15.5 |
| 80 | 132 | 14 | 11 | 147 | 5 | 5 | 12 | 5.5 | M3×6 | 16 | M5×8, φ5.5×20.5 |