

# V-RIBBED PULLEYS IDLER PULLEYS V-PULLEYS

*Highly Cost-Effective Pulleys Developed Using Value Analysis*





*Value analysis yields innovative pulleys and idlers with high performance and reliability but low weight and cost.*

Many V pulleys and other types are used for the auxiliary components of automobile engines and in various other power transmission systems. Recently, there has been a strong demand to reduce the weight and cost of parts and, at the same time, to improve their performance. Through value analysis (VA), NSK developed a line of pulleys made from steel sheet using unique forming methods. These methods, which were first conceived in 1959, have been constantly improved and refined over the years. Many patents (e.g. U.S. Pat. No. 4518374) are

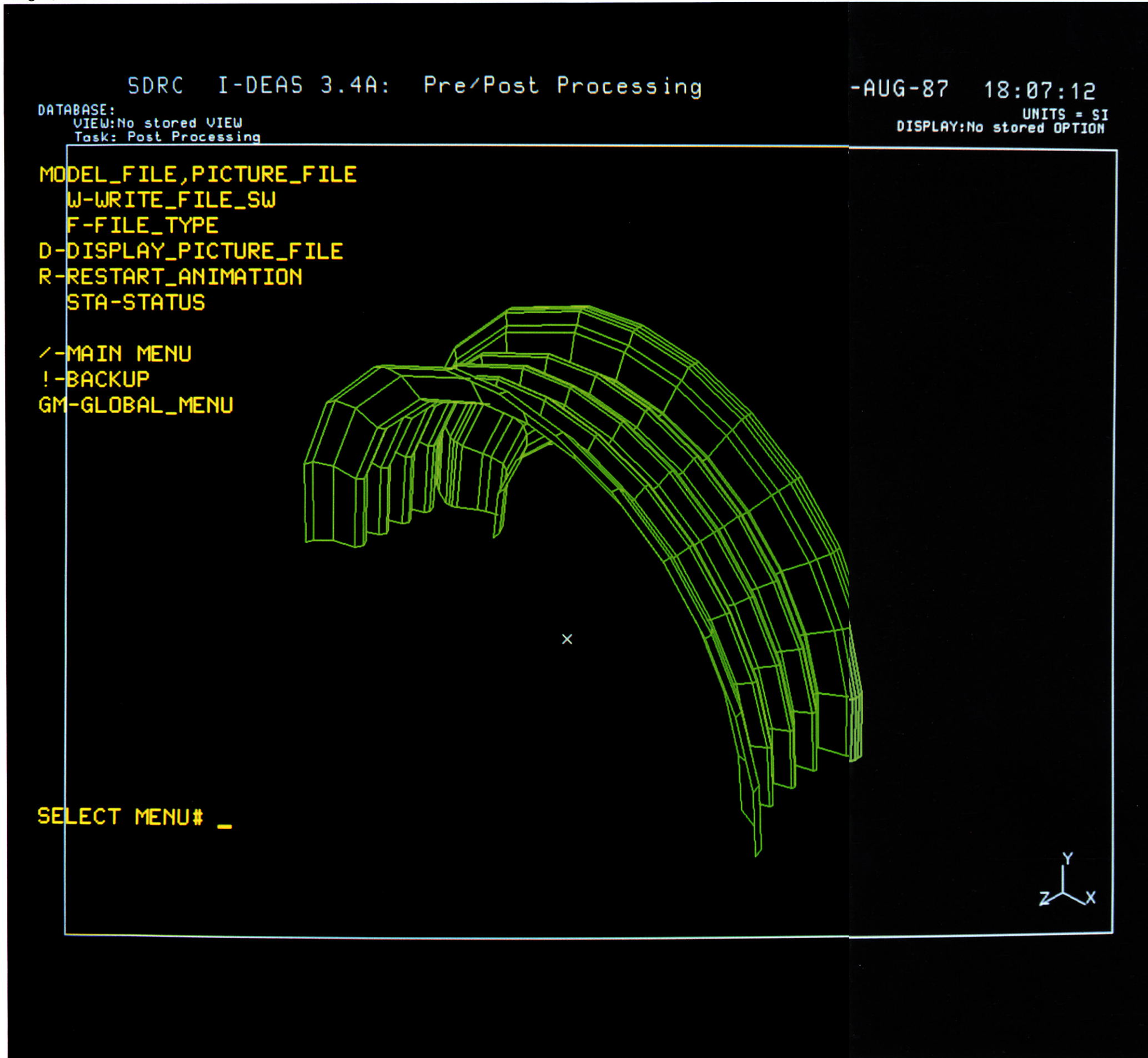
evidence of NSK's pioneering effort in this field. So far, the company has produced over 150 million such pulleys. NSK now supplies a wide variety of pulleys made using its Rotary Forming Method. They feature high strength, precise shape, smooth surface, and low cost. Automobile manufacturers and others making power transmission systems are finding that these units offer convenience and economy as well as high performance.



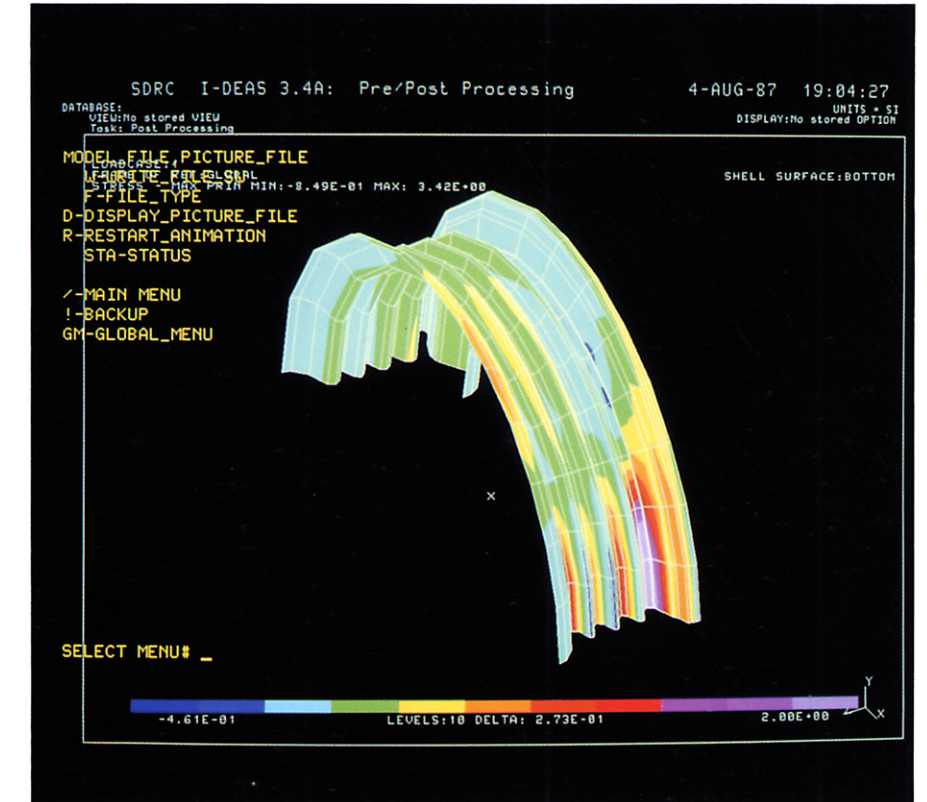


# Computer Aided Design (CAD)

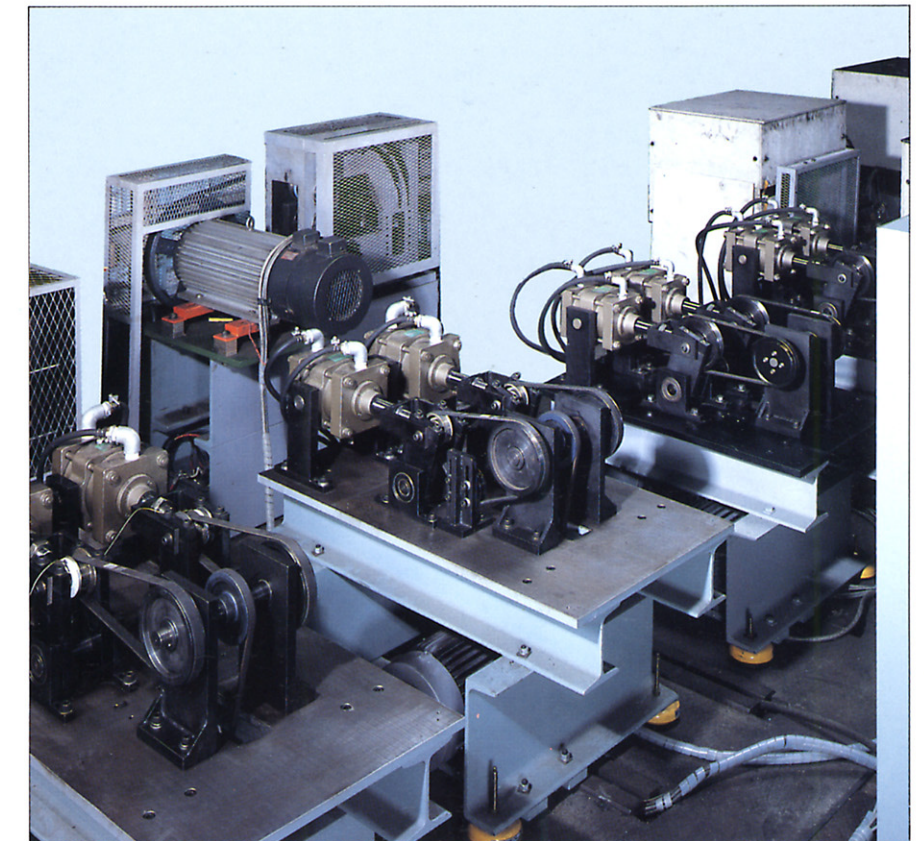
Computers have been instrumental in refining the design of these pulleys. Using the Finite Element Method (FEM), NSK's engineers are able to depict stress distributions under various conditions and learn how to reduce concentrated stress, fatigue, and wear.



FEM Depiction of V-Ribbed Idler



Stress Distribution in V-Ribbed Pulley



Fatigue Test Machines



# Mechanical Strength and Fatigue Test Data

- High strength resulting from well balanced design accomplished using Finite Element Method.
- High geometrical accuracy and good surface finish achieved using unique Rotary Forming Method.

## Mechanical Strength

### 1. FEM Depiction of Stress in V-Ribbed Idler

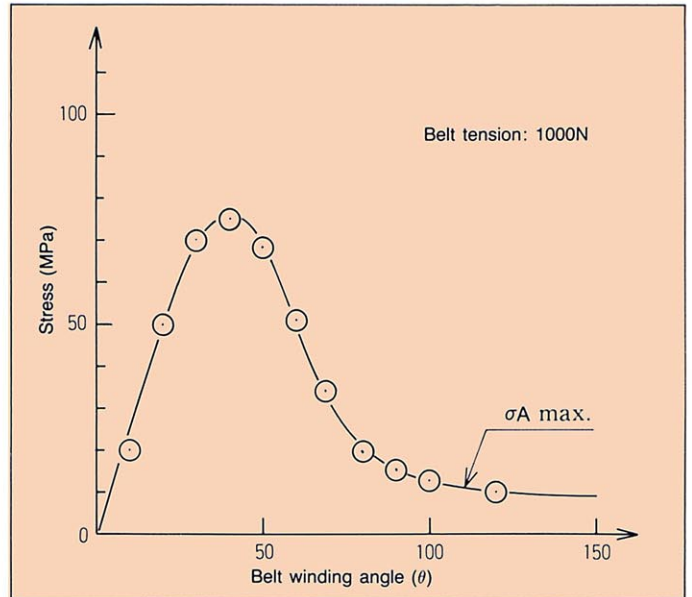
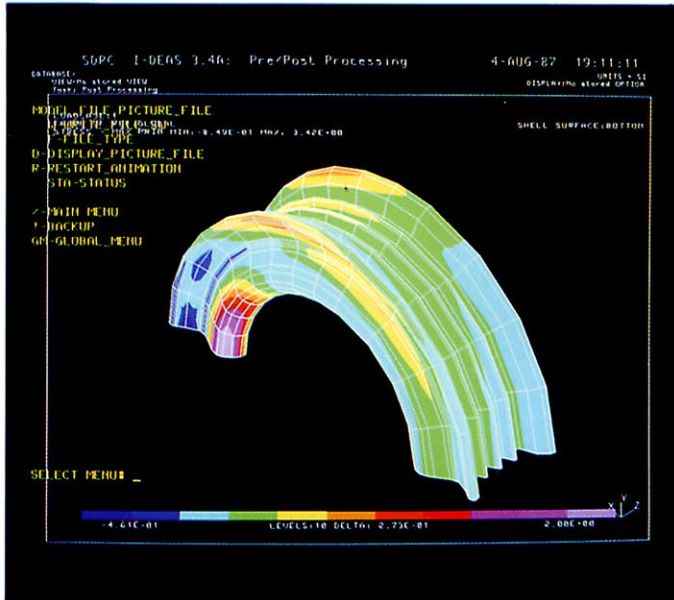
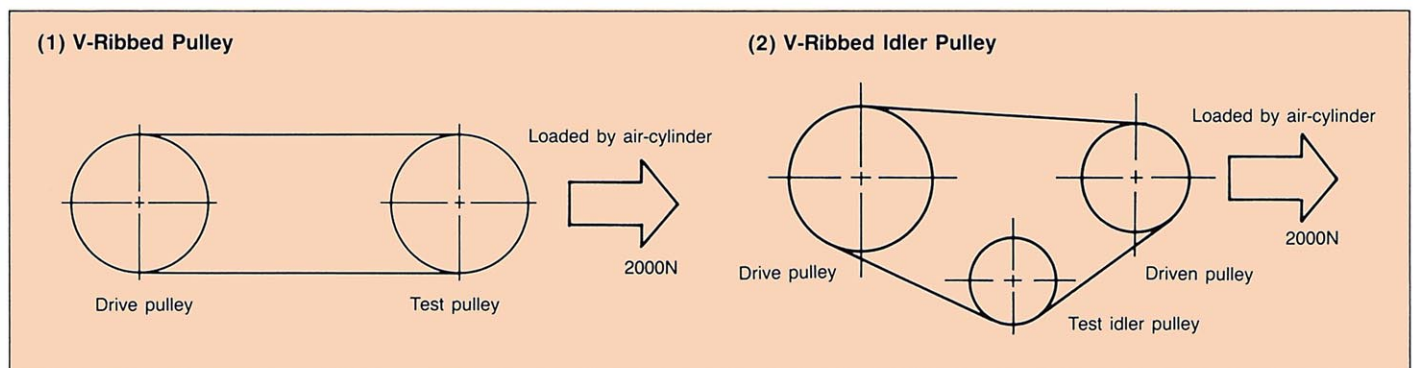


Fig. 1 Relationship between Belt Winding Angle and Stress

### 2. Fatigue Test Method



### 3. Test results

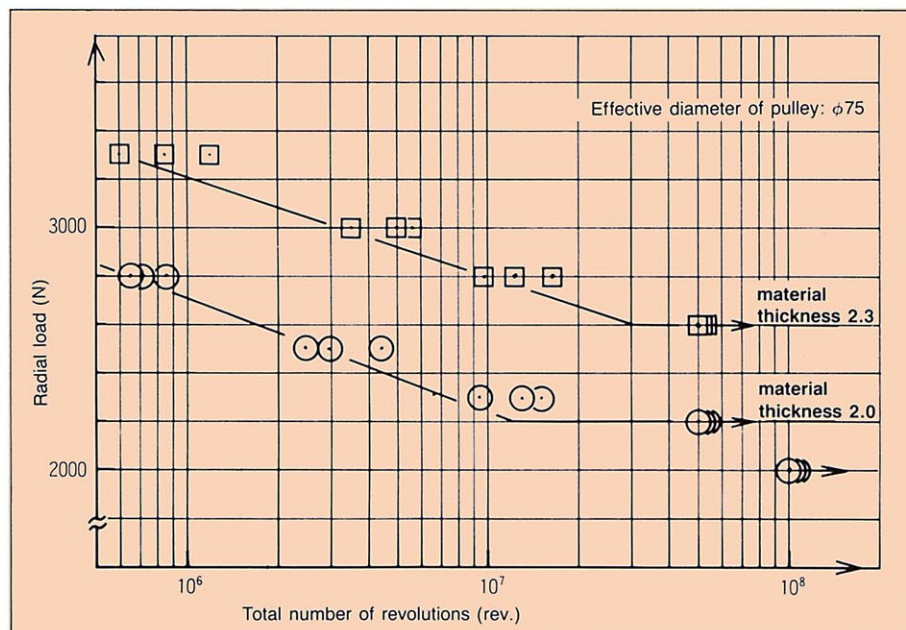
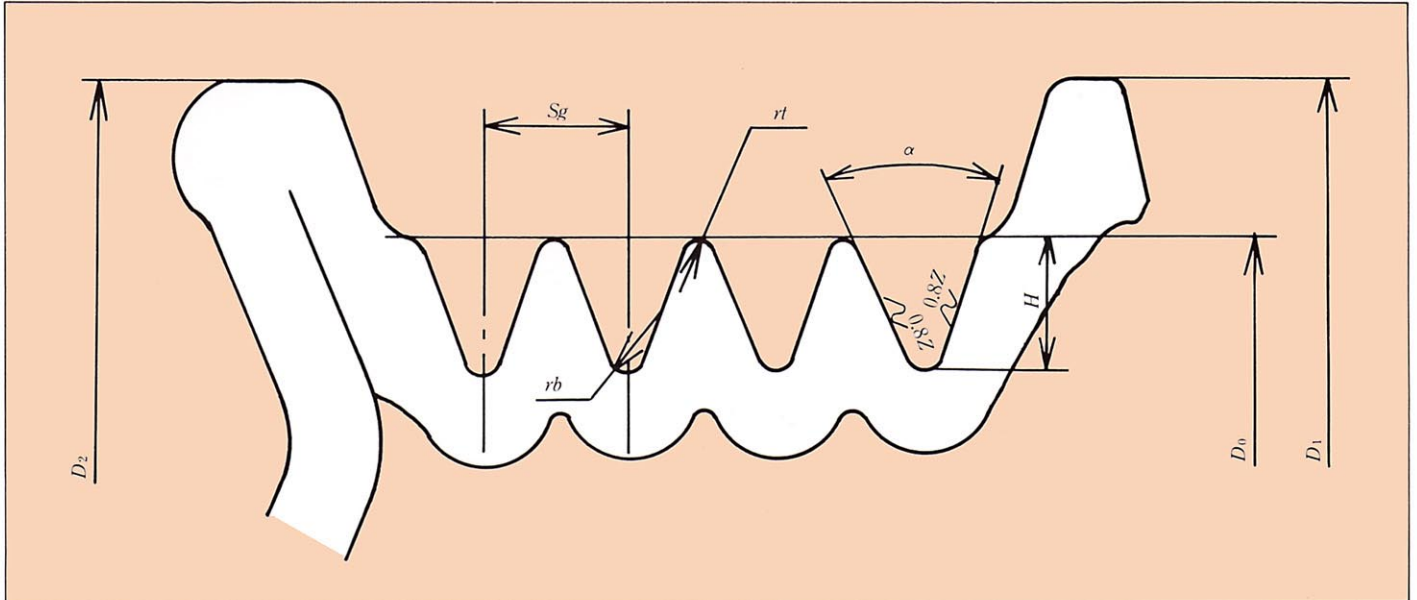


Fig. 2 Results of Fatigue Test of V-Ribbed Idler Pulley

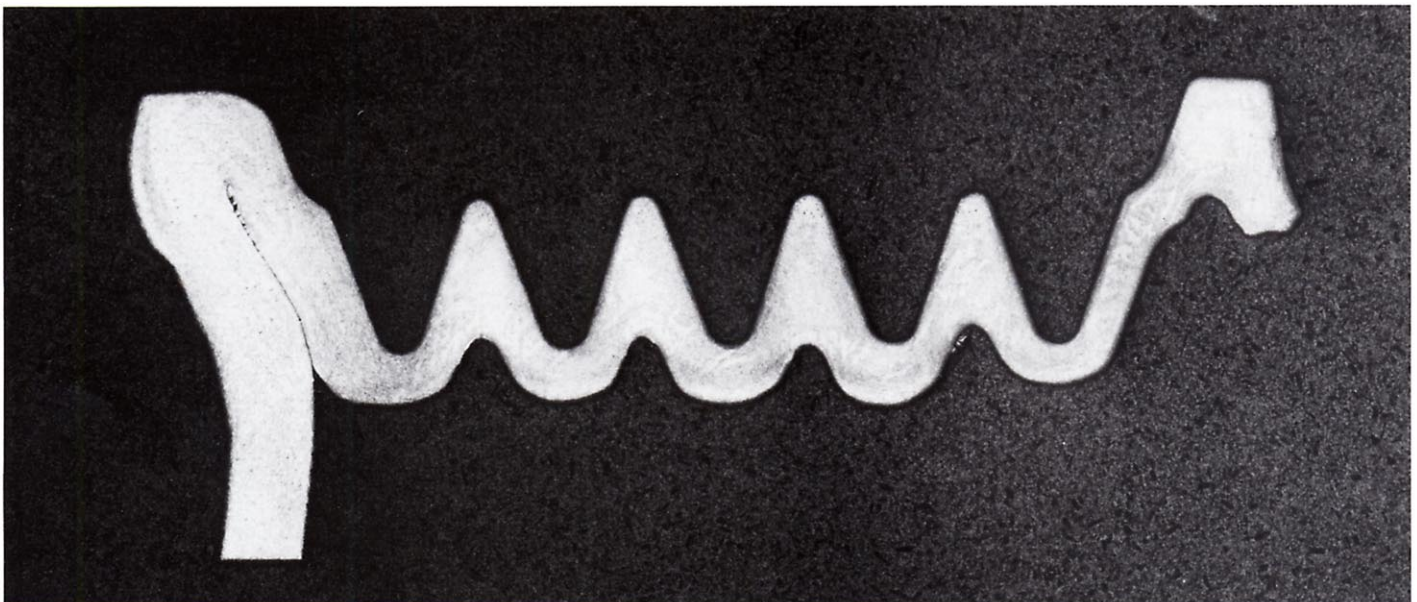


## V-Groove Specifications



| Symbols               | Names                        | Basic Dimensions |
|-----------------------|------------------------------|------------------|
| $D_0$ (Reference)     | Effective diameter           | 100              |
| $D_1$ (Reference)     | Open-side outside diameter   | 105              |
| $D_2$ (Reference)     | Folded-side outside diameter | 105              |
| $\alpha$ ( $^\circ$ ) | Groove angle                 | 40, 38, 36       |
| $S_g$                 | Groove pitch                 | 3, 56            |
| $r_t$                 | Top radius                   | 0.35             |
| $r_b$                 | Recess radius                | 0.5              |
| $H$                   | Groove depth                 | 3.1              |

## Grain Flow



No bending flaws, no cracks, no folds, and continuous grain flow

Grain flow



# V-Ribbed Pulleys

V-ribbed pulleys made by rotary-forming steel sheets are economical and light but still offer high reliability for auxiliary systems for automobiles.

## ● Specification Ranges

Effective diameter ( $D_o$ ):  $\phi 50 \sim \phi 200$   
Number of grooves ( $V$ ): 3~12  
Material thickness ( $t$ ): 2.0~2.8  
Height ( $A$ ): 45 max.

## ● Surface treatment

- Electrodeposition cationic plating
- After electro-galvanizing, yellow chromate treatment, etc.

\* Regarding pulleys for two belts, with either one or two mounting faces, please consult with NSK.

## ● Material

SAE1008



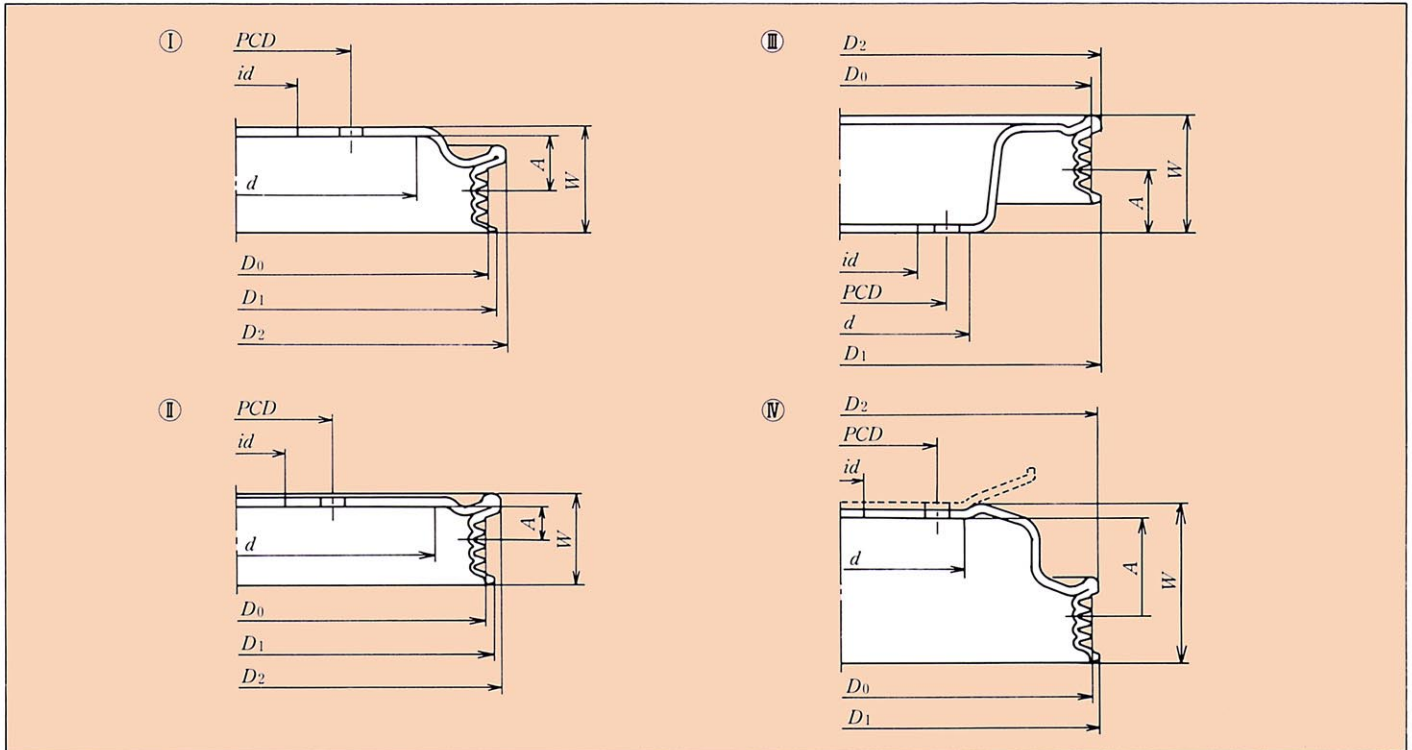
Typical V-Ribbed Pulleys



V-Ribbed Pulley and Its Cross-Section



## Cross-Sections



## Dimension Table

| Pulley Type | Number of Grooves | Effective Diameter | Open-Side Outside Diameter | Folded-Side Outside Diameter | Mounting Hole Pitch | Nominal Bore Diameter | Mounting Face Effective Diameter | Mounting Face Height from Reference Groove | Overall Width | Material Thickness |
|-------------|-------------------|--------------------|----------------------------|------------------------------|---------------------|-----------------------|----------------------------------|--|---------------|--------------------|
|             | $V$               | $D_0$              | $D_1$                      | $D_2$                        | $PCD$               | $id$                  | $d$                              | $A$  | $W$           | $t$                |
| I           | 4                 | 108                | 113                        | 116                          | 44.2                | 30                    | 62                               | 33.82                                      | 46.24         | 2.0                |
|             | 4                 | 122                | 126                        | 130.5                        | 60.3                | 31.75                 | 77.5                             | 25.44                                      | 39.4          | 2.3                |
|             | 3                 | 114                | 119                        | 119                          | 63.4                | 51                    | 80                               | 13.6                                       | 22.6          | 2.0                |
|             | 3                 | 110                | 115                        | 115                          | 35                  | 15.918                | 52                               | 19.5                                       | 21.8          | 2.3                |
|             | 5                 | 130                | 135                        | 137                          | 49                  | 35                    | 67                               | 20.32                                      | 33            | 2.0                |
|             | 5                 | 110                | 115                        | 115                          | 56                  | 32                    | 70                               | 23.94                                      | 28.94         | 2.0                |
|             | 5                 | 118                | 123                        | 126                          | 56                  | 32                    | 68                               | 22.04                                      | 36.66         | 2.0                |
|             | 4                 | 100                | 105                        | 105                          | 56                  | 24                    | 68                               | 11.14                                      | 25.56         | 2.0                |
| II          | 4                 | 113                | 118                        | 121                          | 60.3                | 31.75                 | 80                               | 6.7  | 23.56         | 2.0                |
|             | 4                 | 125                | 130                        | 133.5                        | 50                  | 25                    | 100                              | 8.68                                       | 22.6          | 2.3                |
|             | 4                 | 129                | 134                        | 137.5                        | 50                  | 25                    | 104                              | 8.68                                       | 22.6          | 2.3                |
|             | 4                 | 137                | 142                        | 145                          | 60.3                | 31.75                 | 108                              | 6.72                                       | 23.54         | 2.0                |
| III         | 4                 | 106                | 111                        | 114                          | 50                  | 28                    | 64                               | 3.3  | 21.62         | 2.0                |
|             | 4                 | 130                | 136                        | 138.5                        | 44.2                | 30                    | 62                               | 37.38                                      | 49.1          | 2.3                |
|             | 4                 | 130                | 135                        | 135                          | 55                  | 40                    | 68                               | 20.12                                      | 30            | 2.0                |
|             | 4                 | 133                | 136                        | 141                          | 58                  | 36                    | 88                               | 2.4  | 20.7          | 2.3                |
|             | 5                 | 100                | 105                        | 108                          | 50                  | 28                    | 65                               | 0.58                                       | 26.18         | 2.0                |
|             | 5                 | 100                | 105                        | 108                          | 50                  | 28                    | 65                               | 1.42                                       | 26            | 2.0                |
|             | 5                 | 135                | 140                        | 143.5                        | 53                  | 25                    | 67                               | 4.98                                       | 27.1          | 2.3                |
|             | 5                 | 146                | 151                        | 154.5                        | 62                  | 44                    | 88                               | 6.95                                       | 27.19         | 2.3                |
| IV          | 4                 | 133                | 137                        | 137                          | 50                  | 12                    | 65                               | 25.92                                      | 42            | 2.6                |

\*This table presents dimensions of production pulleys.



# Idler Pulleys

Idler pulleys are used to adjust belt tension between the driving pulley and other pulleys for air-conditioner compressors, power steering pumps, superchargers, and alternators of automobiles. An NSK idler pulley is a combination of a high performance bearing and a light but strong pulley with high accuracy fitting.

## • Specification Ranges

|                               | (V-ribbed)        | (Flat)             | (V)                |
|-------------------------------|-------------------|--------------------|--------------------|
| Effective diameter ( $D_e$ ): | $\phi 70 \sim 90$ | $\phi 90 \sim 100$ | $\phi 70 \sim 100$ |
| Number of grooves ( $V$ ):    | 3~7               | —                  | 1                  |
| Material thickness ( $t$ ):   | 2.3~2.6           | 2.0~2.3            | 1.6~2.0            |

\* For special specifications, please contact NSK.

## • Material

SAE1008

## • Surface treatment

- Electrodeposition cationic plating
- After electro-galvanizing, yellow chromate treatment

## • High Performance Bearings

- Low torque, high performance seals for reliability
- Packed with high quality grease for long life at high speeds and low temperature rise.

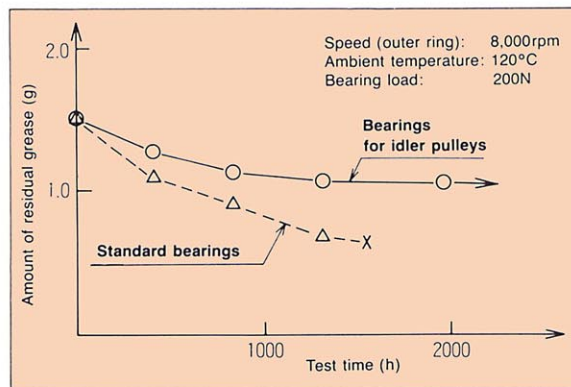
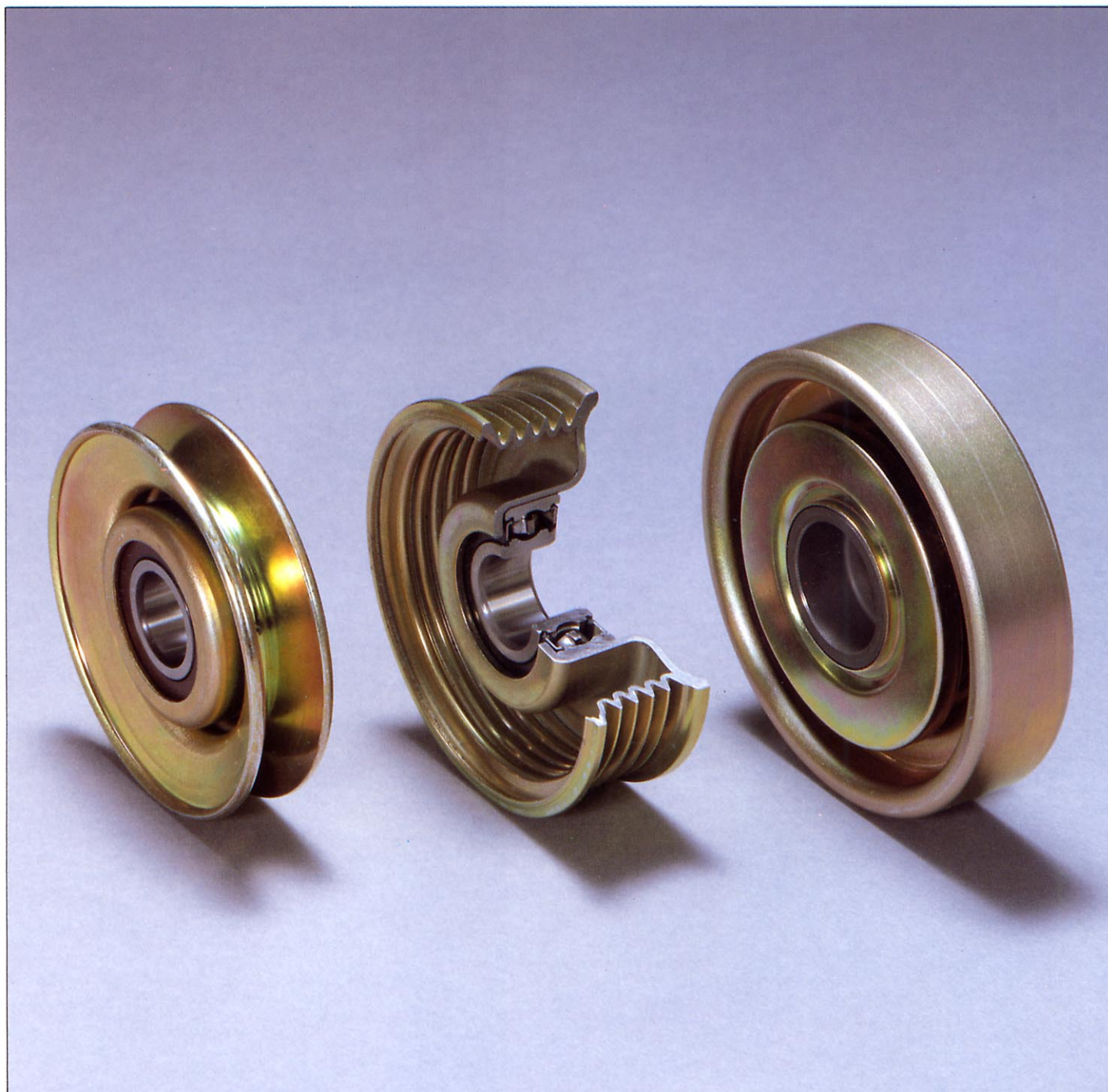
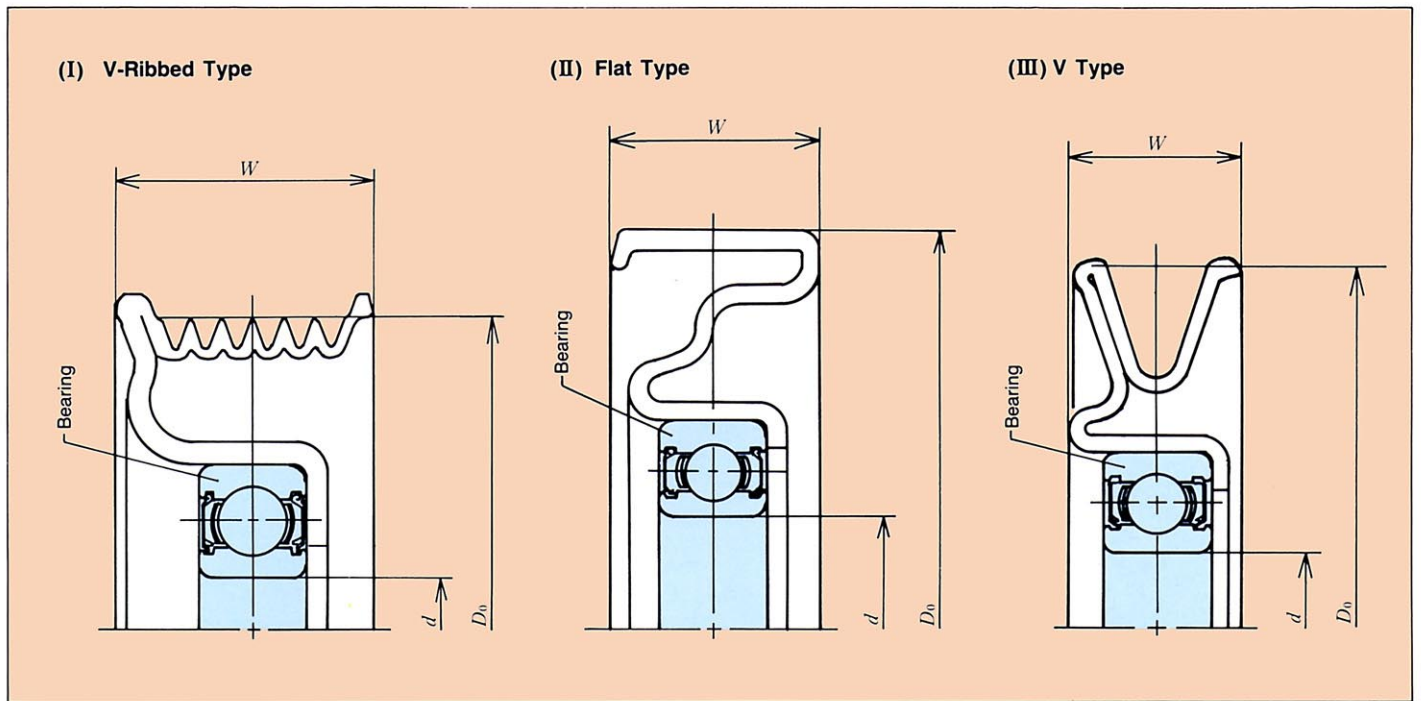


Fig. 3 Results of Endurance Test





## Cross-Section



## Dimension Table

| Pulley Type | Effective Diameter $D_o$ | Bearing Bore Diameter $d$ | Overall Width $W$ | Number of Grooves $V$ | Material thickness $t$ | Mass (g) | Bearing Numbers |
|-------------|--------------------------|---------------------------|-------------------|-----------------------|------------------------|----------|-----------------|
| V-Ribbed    | 70                       | 12                        | 28.30             | 6                     | 2.6                    | 280      | 6301            |
|             | 70                       | 15                        | 21.68             | 4                     | 2.3                    | 250      | 6302            |
|             | 70                       | 17                        | 21.68             | 4                     | 2.3                    | 230      | 6203            |
|             | 75                       | 17                        | 26.70             | 5                     | 2.3                    | 275      | 6203            |
|             | 80                       | 12                        | 22.40             | 4                     | 2.3                    | 260      | 6301            |
|             | 90                       | 20                        | 28.30             | 6                     | 2.6                    | 400      | 6304            |
| Flat        | 80                       | 25                        | 23.5              | —                     | 2.0                    | 265      | 6005            |
|             | 90                       | 20                        | 25.5              | —                     | 2.0                    | 340      | 6304            |
|             | 90                       | 25                        | 23.5              | —                     | 2.0                    | 280      | 6005            |
| V           | 75                       | 12                        | 18.3              | 1                     | 1.6                    | 200      | 6301            |
|             | 75                       | 17                        | 18.8              | 1                     | 1.8                    | 220      | 6203            |
|             | 80                       | 17                        | 19.3              | 1                     | 1.6                    | 220      | 6203            |
|             | 90                       | 20                        | 23.5              | 1                     | 2.0                    | 370      | 6204            |
|             | 100                      | 20                        | 19.8              | 1                     | 2.0                    | 380      | 6204            |

\*This table presents the dimensions of production idlers.



# V pulleys

V pulleys are used to drive auxiliary components of automobiles, agricultural machines, and parts of various power transmission systems.

- **Specification Ranges**

- Effective diameter ( $D_o$ ):  $\phi 50 \sim \phi 300$

- Material thickness ( $t$ ): 1.6 ~ 2.6

- Height ( $A_o, A_i$ ): 60 max.

- **Material**

- SAE1008

- **Surface treatment**

- Electrodeposition cationic plating

- After electro-galvanizing, yellow chromate treatment



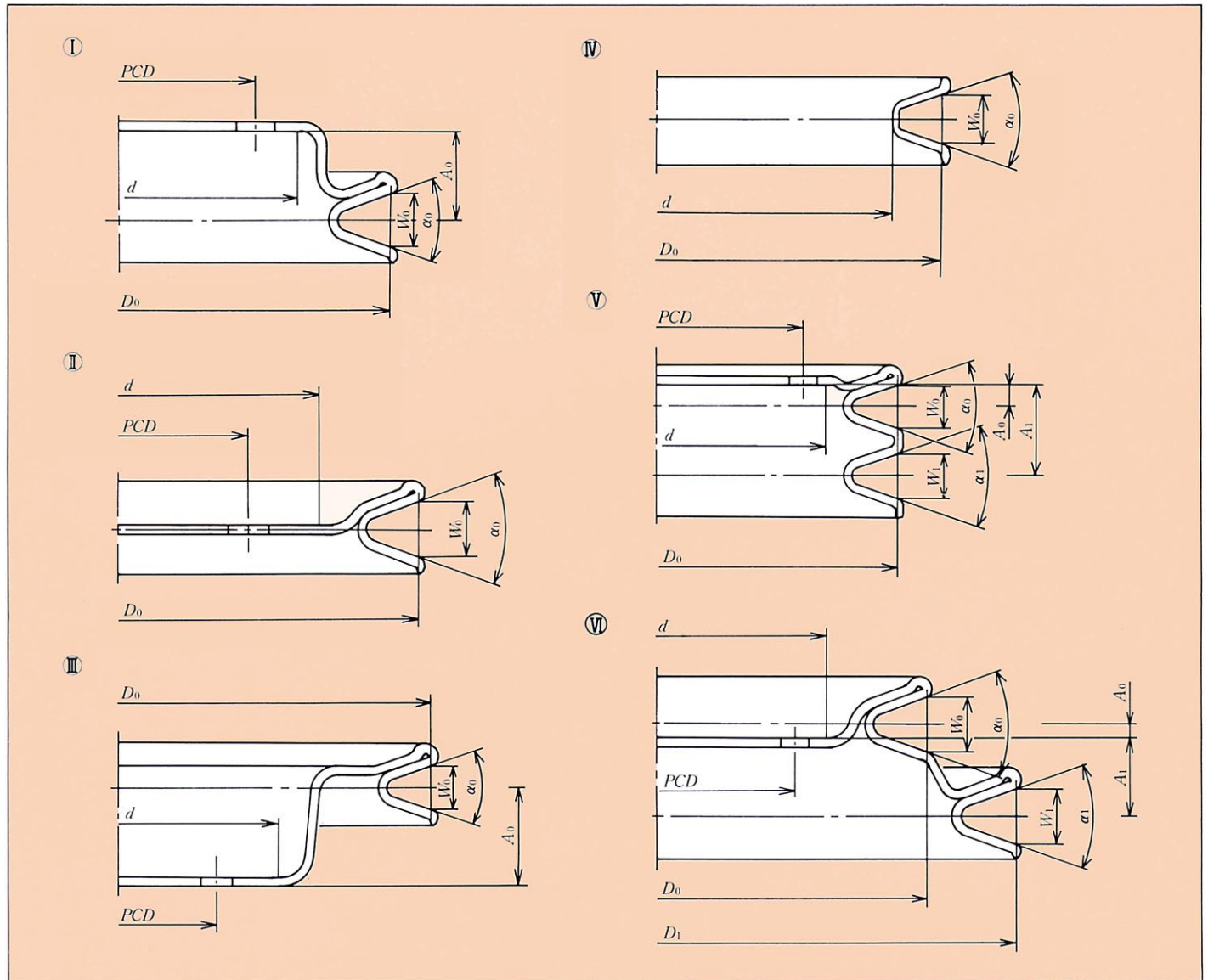
Typical V pulleys



Double V pulley (same dia.) and cross-section of stepped double pulley



## Cross-Sections



## Dimension Table

| Pulley Type | Effective Diameter |       | Dia. of Flat Mounting Surface | Effective Width |       | Groove Angle (°) |            | Height from Mounting Face |       | Material Thickness | Mounting Hole Pitch |
|-------------|--------------------|-------|-------------------------------|-----------------|-------|------------------|------------|---------------------------|-------|--------------------|---------------------|
|             | $D_0$              | $D_1$ | $d$                           | $W_0$           | $W_1$ | $\alpha_0$       | $\alpha_1$ | $A_0$                     | $A_1$ |                    |                     |
| I           | 126                | —     | 86                            | 11.7            | —     | 38               | —          | 36                        | —     | 2.0                | 63.5                |
|             | 138                | —     | 60                            | 9.5             | —     | 36               | —          | 13                        | —     | 1.6                | 42.0                |
| II          | 110                | —     | 64                            | 15.9            | —     | 34               | —          | 0                         | —     | 1.6                | 44.0                |
|             | 140                | —     | 80                            | 11.7            | —     | 38               | —          | 0                         | —     | 2.0                | 60.0                |
| III         | 145                | —     | 76                            | 9.5             | —     | 36               | —          | 19.8                      | —     | 2.0                | 44.2                |
|             | 155                | —     | 62                            | 11.7            | —     | 38               | —          | 35.6                      | —     | 2.0                | 44.2                |
| IV          | 115                | —     | 92.8                          | 9.5             | —     | 36               | —          | 0                         | —     | 2.0                | —                   |
|             | 135                | —     | 108                           | 12.7            | —     | 36               | —          | 0                         | —     | 2.0                | —                   |
| V           | 92                 | —     | 53                            | 9.5             | —     | 36               | —          | 46.5                      | 61.5  | 2.0                | 44.0                |
|             | 112                | —     | 81                            | 9.5             | —     | 36               | —          | 4.5                       | 19.5  | 2.0                | 66.0                |
| VI          | 124                | 154   | 90                            | 11.7            | 9.5   | 38               | 36         | 2.7                       | 17.3  | 2.0                | 63.4                |
|             | 124                | 165   | 95                            | 11.7            | 11.7  | 38               | 38         | 2.7                       | 17.3  | 2.0                | 63.4                |

\*This table presents the dimensions of production pulleys.