

| Machine classification | Piston ring and (sleeve) manufacturing process classification | Basic machine elements |           |         |                |                 |                     |                |                |                |                             | Piston ring               |             |              |             |                   |                   |             |                  |                 |                |                 |                    |            |        |                   |           |                          |                  |         |             |          |        |            |        |                   |           |                          |                |             |          |            |             |                   |             |                  |                 |                             |                |                |                |                     |                 |                |         |           |                      |           |          |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |
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|                        |                                                               |                        |           |         |                |                 |                     |                |                |                |                             | Ultra-small-sized         | Small-sized | Medium-sized | Large-sized | Extra-large-sized |                   |             |                  |                 |                |                 |                    |            |        |                   |           |                          |                  |         |             |          |        |            |        |                   |           |                          |                |             |          |            |             |                   |             |                  |                 |                             |                |                |                |                     |                 |                |         |           |                      |           |          |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |
|                        |                                                               |                        |           |         |                |                 |                     |                |                |                |                             | Cast Iron                 |             |              |             |                   |                   |             |                  |                 |                |                 |                    |            |        |                   |           |                          |                  |         |             |          |        |            |        |                   |           |                          |                |             |          |            |             |                   |             |                  |                 |                             |                |                |                |                     |                 |                |         |           |                      |           |          |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |
|                        |                                                               |                        |           |         |                |                 |                     |                |                |                |                             | Steel                     |             |              |             |                   |                   |             |                  |                 |                |                 |                    |            |        |                   |           |                          |                  |         |             |          |        |            |        |                   |           |                          |                |             |          |            |             |                   |             |                  |                 |                             |                |                |                |                     |                 |                |         |           |                      |           |          |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |
|                        |                                                               |                        |           |         |                |                 |                     |                |                |                |                             | Gasoline Engine           |             |              |             |                   |                   |             |                  |                 |                |                 |                    |            |        |                   |           |                          |                  |         |             |          |        |            |        |                   |           |                          |                |             |          |            |             |                   |             |                  |                 |                             |                |                |                |                     |                 |                |         |           |                      |           |          |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |
|                        |                                                               |                        |           |         |                |                 |                     |                |                |                |                             | Diesel Engine             |             |              |             |                   |                   |             |                  |                 |                |                 |                    |            |        |                   |           |                          |                  |         |             |          |        |            |        |                   |           |                          |                |             |          |            |             |                   |             |                  |                 |                             |                |                |                |                     |                 |                |         |           |                      |           |          |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |
|                        |                                                               |                        |           |         |                |                 |                     |                |                |                |                             | 0 10 50 100 200 1000 2000 |             |              |             |                   |                   |             |                  |                 |                |                 |                    |            |        |                   |           |                          |                  |         |             |          |        |            |        |                   |           |                          |                |             |          |            |             |                   |             |                  |                 |                             |                |                |                |                     |                 |                |         |           |                      |           |          |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |        |                                       |         |                       |        |                   |                     |                   |                     |   |   |          |            |   |   |               |              |          |         |             |                                  |        |         |                                       |                       |
| Function               | Structure                                                     | Number of work heads   | Ring type | Process | Machining spot | Machining shape | Work damping system | Work head side | Tailstock side | Closing sleeve | Number of 1-cycle machining | Possible machining        | Cutting-off | Grooving     | Chamfering  | End surface       | Both-side surface | Single-side | Outside diameter | Inside diameter | Operation mode | NC control axis | Work transfer unit | In-stocker | Others | Wheel (tool) head | Work head | Number of wheels (tools) | Deburring device | Dresser | Out-stocker | Unloader | Loader | In-stocker | Others | Wheel (tool) head | Work head | Number of wheels (tools) | Operation mode | Cutting-off | Grooving | Chamfering | End surface | Both-side surface | Single-side | Outside diameter | Inside diameter | Number of 1-cycle machining | Closing sleeve | Tailstock side | Work head side | Work damping system | Machining shape | Machining spot | Process | Ring type | Number of work heads | Structure | Function | Grinding | Horizontal | X | 1 | Keystone ring | Pressure/oil | Grinding | Surface | Cham-ferrng | Both-side and out-side diameters | Single | Closing | Both-side pressing (both-side moving) | Electromagnetic chuck | Single | Both-side pressing (both-side moving) | Closing | Electromagnetic chuck | Single | Both-side surface | Single-side surface | Both-side surface | Single-side surface | X | 2 | Grinding | Horizontal | X | 1 | Keystone ring | Pressure/oil | Grinding | Surface | Cham-ferrng | Both-side and out-side diameters | Single | Closing | Both-side pressing (both-side moving) | Electromagnetic chuck | Single | Both-side pressing (both-side moving) | Closing | Electromagnetic chuck | Single | Both-side surface | Single-side surface | Both-side surface | Single-side surface | X | 2 | Grinding | Horizontal | X | 1 | Keystone ring | Pressure/oil | Grinding | Surface | Cham-ferrng | Both-side and out-side diameters | Single | Closing | Both-side pressing (both-side moving) | Electromagnetic chuck | Single | Both-side pressing (both-side moving) | Closing | Electromagnetic chuck | Single | Both-side surface | Single-side surface | Both-side surface | Single-side surface | X | 2 | Grinding | Horizontal | X | 1 | Keystone ring | Pressure/oil | Grinding | Surface | Cham-ferrng | Both-side and out-side diameters | Single | Closing | Both-side pressing (both-side moving) | Electromagnetic chuck | Single | Both-side pressing (both-side moving) | Closing | Electromagnetic chuck | Single | Both-side surface | Single-side surface | Both-side surface | Single-side surface | X | 2 | Grinding | Horizontal | X | 1 | Keystone ring | Pressure/oil | Grinding | Surface | Cham-ferrng | Both-side and out-side diameters | Single | Closing | Both-side pressing (both-side moving) | Electromagnetic chuck | Single | Both-side pressing (both-side moving) | Closing | Electromagnetic chuck | Single | Both-side surface | Single-side surface | Both-side surface | Single-side surface | X | 2 | Grinding | Horizontal | X | 1 | Keystone ring | Pressure/oil | Grinding | Surface | Cham-ferrng | Both-side and out-side diameters | Single | Closing | Both-side pressing (both-side moving) | Electromagnetic chuck | Single | Both-side pressing (both-side moving) | Closing | Electromagnetic chuck | Single | Both-side surface | Single-side surface | Both-side surface | Single-side surface | X | 2 | Grinding | Horizontal | X | 1 | Keystone ring | Pressure/oil | Grinding | Surface | Cham-ferrng | Both-side and out-side diameters | Single | Closing | Both-side pressing (both-side moving) | Electromagnetic chuck | Single | Both-side pressing (both-side moving) | Closing | Electromagnetic chuck | Single | Both-side surface | Single-side surface | Both-side surface | Single-side surface | X | 2 | Grinding | Horizontal | X | 1 | Keystone ring | Pressure/oil | Grinding | Surface | Cham-ferrng | Both-side and out-side diameters | Single | Closing | Both-side pressing (both-side moving) | Electromagnetic chuck | Single | Both-side pressing (both-side moving) | Closing | Electromagnetic chuck | Single | Both-side surface | Single-side surface | Both-side surface | Single-side surface | X | 2 | Grinding | Horizontal | X | 1 | Keystone ring | Pressure/oil | Grinding | Surface | Cham-ferrng | Both-side and out-side diameters | Single | Closing | Both-side pressing (both-side moving) | Electromagnetic chuck | Single | Both-side pressing (both-side moving) | Closing | Electromagnetic chuck | Single | Both-side surface | Single-side surface | Both-side surface | Single-side surface | X | 2 | Grinding | Horizontal | X | 1 | Keystone ring | Pressure/oil | Grinding | Surface | Cham-ferrng | Both-side and out-side diameters | Single | Closing | Both-side pressing (both-side moving) | Electromagnetic chuck |