# Retaining rings & pins

Holding parts on a shaft or in a bore without threads — retaining rings (circlips), dowel and spring pins, and the grooves and holes they need.

| REVISION | ISSUED | OWNER | COMPANION |
|---|---|---|---|
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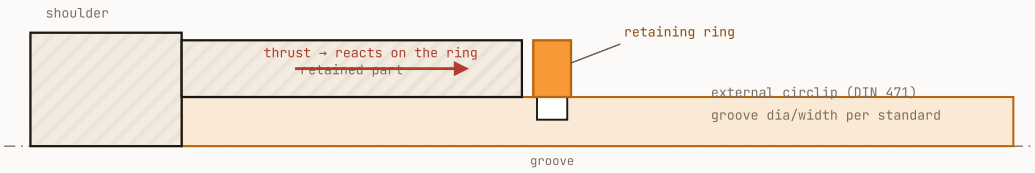
ABSTRACT

Retaining rings and pins are the small, standard machine elements that locate and retain parts without threads — fast to assemble, cheap, and standardised. Rings take axial load (hold a bearing on a shaft); pins take location and shear (align two parts, carry torque). Choosing and grooving them correctly avoids pop-outs and loose fits.

Section 1 frames the options. Section 2 is retaining rings (circlips). Section 3 is pins. Section 4 is selection by function. Section 5 is groove and hole design. Section 6 is failure modes and a checklist.

RETAINING RING — AXIAL RETENTION IN A GROOVE




A RETAINING RING DROPS INTO A GROOVE AND REACTS AXIAL THRUST AGAINST THE PART IT HOLDS — NO THREAD, FAST ASSEMBLY. PINS HANDLE LOCATION AND SHEAR; RINGS HANDLE AXIAL RETENTION.

CONTENTS

# 1. Retention and location options

- **Retaining ring (circlip / snap ring): axial retention in a groove**
  the standard way to hold a bearing, gear or pulley on a shaft or in a bore.
- **Dowel pin: precise**
  location
  **between two parts (press fit in a reamed hole).**
- **Spring (roll) pin: location/torque in forgiving holes**
  self-retaining, cheap.
- **Cotter / clevis pin: serviceable pivot or removable retention.**
- **Use a ring instead of a nut/snap-fit when you want fast, repeatable axial retention; use a pin when you need alignment or shear transfer.**

| | |
|---|---|
| `External ring` | Sits in a groove on a shaft (DIN 471) — retains from outside |
| `Internal ring` | Sits in a groove in a bore (DIN 472) — retains from inside |
| `Thrust load` | Axial force the ring reacts; rings "dish" and can pop out if overloaded |
| `Dowel pin` | Ground precision pin for location, press-fit in a reamed hole |
| `Spring pin` | Hollow slotted/coiled pin that grips a drilled hole by spring force |

## 2. Retaining rings (circlips)

| RING TYPE | NOTES |
|---|---|
| **External / internal (DIN 471 / 472)** | tapered-section, installed with pliers; the default |
| **E-clip** | snaps onto a groove from the side; light loads, fast |
| **Spiral (constant-section)** | no lugs, 360° contact, clean OD, higher thrust |
| **Self-locking / push-on** | no groove needed; permanent, light loads |
| **Reinforced / bowed** | higher thrust or take-up of end play |

- **Thrust capacity is limited by the ring dishing out of the groove and by groove wall yielding**
  heavily loaded joints want a spiral or reinforced ring and a sharp-cornered groove.
- **Add a chamfer/lead-in so the ring expands over the shaft to the groove during assembly.**

## 3. Pins

| PIN | HOLE | USE |
|---|---|---|
| **Dowel (ground)** | reamed H7, press fit | precise location between parts |
| **Spring (slotted/coiled)** | drilled, forgiving | location + light torque, self-retaining |
| **Clevis + cotter** | clearance | removable pivot |
| **Grooved** | drilled | press-retained, no reaming |
| **Taper** | reamed taper | precise location + light torque |
| **Cotter / split** | clearance | secure a castle nut / clevis |

Dowels carry **location and shear** but not tension — don't rely on a dowel to clamp. Two dowels (not three) locate a part fully; use clearance on extra pins to avoid over-constraint.

## 4. Selection by function

- Axial retention → retaining ring (spiral/reinforced for high thrust).
- Precise location → two dowel pins (reamed H7) plus bolts for clamping.
- Torque / shear in a forgiving hole → spring or grooved pin.
- Serviceable pivot → clevis + cotter.
- Cheapest light-duty retention → e-clip or push-on.

## 5. Groove and hole design

- **Ring grooves: use the standard groove diameter, width and corner radius for the ring (DIN 471/472 tables)**
  an off-spec groove drops thrust capacity and lets the ring tilt. Keep the groove a sharp corner on the load side.
- **Edge distance: leave enough shaft beyond the groove (margin) so the land doesn't shear out under thrust.**
- **Dowel holes: ream to H7 for the dowel's press fit; align-ream mating parts together for true location. Provide a blind-hole vent or use a relieved/ pull-out dowel for serviceability.**
- **Chamfers everywhere the ring or pin enters**
  assembly damage and shaved grooves come from sharp lead-ins.

## 6. Failure modes and checklist

| MODE | CAUSE | FIX |
|---|---|---|
| **Ring dishes / pops out** | thrust > capacity, shallow groove | spiral/reinforced ring, deeper sharp groove, support face |
| **Groove wall yields** | soft shaft, high thrust | harder shaft, larger groove, spread the load |
| **Pin shears** | overload, undersized | larger/stronger pin, more pins, share load |
| **Dowel hole wears / loosens** | repeated load, clearance fit | reamed H7 press fit, harder parts, more dowels |
| **Spring pin walks out** | wrong size/hole | correct pin OD vs hole, double pin |

**Checklist:** axial retention or location? → ring (size for thrust; spiral/reinforced if high) or dowel/spring pin (size for shear) → use the standard groove (DIN 471/472) or reamed H7 hole → adequate edge distance and chamfers → don't over-constrain with extra dowels.