

The Punching Machine

MARIAUD CONSULTING



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The Punching Machine

01 Presentation

The Punching Machine

The **punching machine** is a machine designed to **precisely punch holes** in metal elements, notably **the hoops used in cooepage**.

The punching machine is composed of two main elements:

- **The punch:** a **tempered steel rod**, sharpened, which descends vertically to pierce the metal.
- **The die:** a **fixed piece**, hollowed out with a hole of the same diameter, placed under the punch. It guides the punch's penetration and **receives the cut piece of metal**.

▶ When the machine is activated (manually or via a hydraulic jack), the punch is pushed against the sheet metal (the hoop), pierces it, and the small metal disk is evacuated into the die.

Two types of punching machines used in cooepage:

Manual Punching Machine:

- Activated by hand, with a **lever or an arm of force**.
- Adapted to small hoops or small series.
- Requires **more physical effort**, but remains **robust, reliable, and precise**.

Hydraulic Punching Machine:

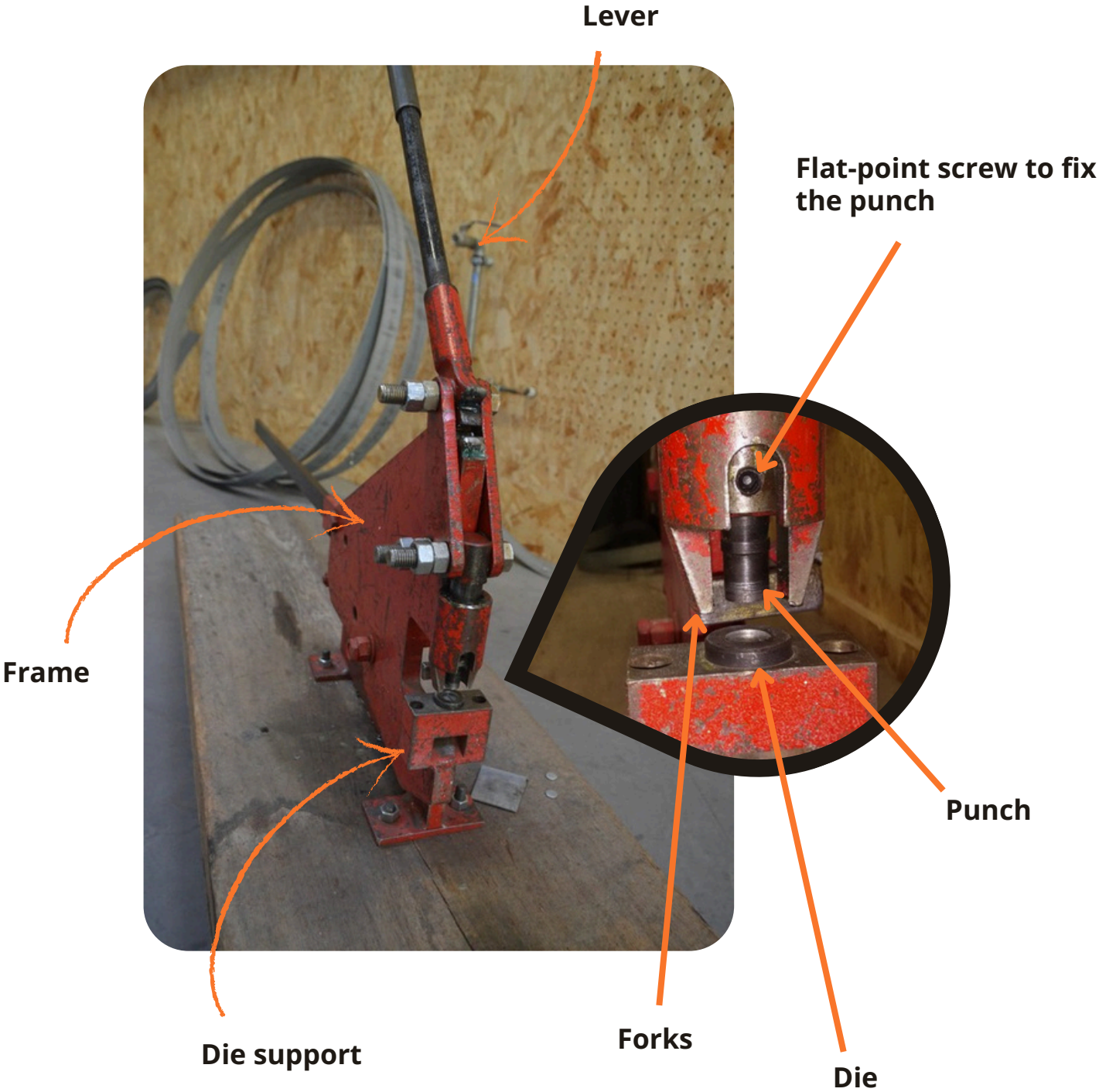
- Activated by a **hydraulic jack**.
- Allows work **without effort** on hoops of larger diameter.
- Often used in more industrialized workshops or for **the hooping of large vats**.



The Punching Machine

02

Terminology



The Punching Machine

02 Terminology

Operation of a Manual Punching Machine

The **manual punching** machine is a simple, robust machine, designed for workshop use without electrical power.

Usage:

- It is sufficient **to position the hoop** correctly between the **punch** (on top) and the **die** (below).
- Then, activate the large steel lever.
- The punch descends and pierces the clean hole in the metal, exactly at the intended spot.

➡ Thanks to the leverage effect, the operator provides little effort, even on thick hoops.

1. Frame of the Punching Machine

Structure: the frame

The largest part of the punching machine is called **the frame**.

It is a **solid steel block**, often machined from **a thick steel sheet**, which ensures **the stability and resistance** of the assembly.

The frame houses:

- **The lever** and its axis of rotation,
- **The punch**, guided vertically,
- **And the die**, perfectly aligned.

⚠ A deformed or poorly maintained frame = inaccurate holes, poor repeatability, premature wear.

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2. The Punching Lever – Gear Transmission

The lever of the manual punching machine works thanks to a gear transmission system.

How it works:

- **Teeth** (metal notches) are **machined directly into the frame**.
- Others are machined onto **the base of the lever**.
- When the lever is activated, the teeth mesh, which efficiently **transmits the force** towards the punch.

☞ This system ensures:

- **Good guidance** of the movement.
- **Force transmission** without slipping.
- **Precision and repeatability of the punching**.



💡 **The longer the lever, the easier the punching is to execute.**
This is a **direct application of the mechanical lever principle**:

$$\text{Force} \times \text{lever arm} = \text{transmitted power}$$



Lever Securing

The illustrated model is equipped with **two torsion springs**.
Their role is to:

- Maintain the lever **in the high position** at rest.
- Prevent involuntary descents.
- **Improve safety** during hoop positioning.

✅ This type of lever is particularly adapted for workshops where several operators share the machine, as it **limits the risks of improper maneuver**.



The Punching Machine

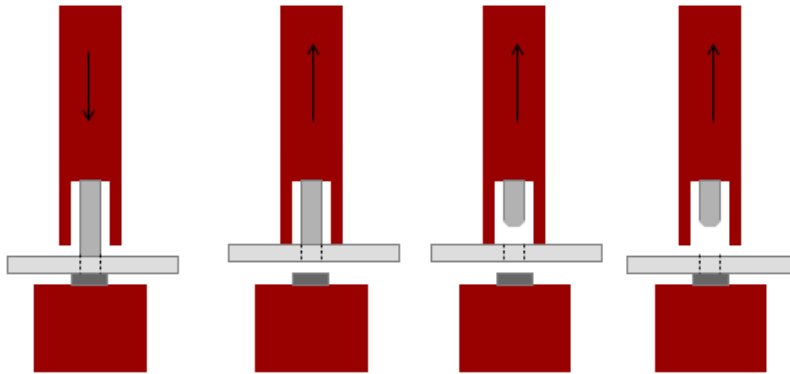
02 Terminologie

2. Side Forks – Punch Release

On certain models of punching machines, we find two **side forks** positioned on both sides of the punch.

🎯 Their role is simple but essential:

- During the **punch's ascent**, these forks **slightly separate the hoop**.
- This allows the **punch itself to be released, without the hoop catching or rising with the rod**.



Punching Steps with Fixed Forks

Punch Descent (Descente du poinçon)

→ The punch passes through the hoop, **guided by the die**.
The hoop is cleanly pierced.

Ascent (Remontée)

→ The punch begins to rise.

The fixed forks retain the hoop, preventing it from rising with the punch.

Release (Déclenchement)

→ Thanks to the blocking by the forks, the **punch disengages from the pierced metal** effortlessly.

Drop (Retombée)

→ The hoop **naturally falls onto the die**, ready to be removed or repositioned.

The Punching Machine

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3. The Hydraulic Punching Machine

Today, in cooperation, we also find **hydraulic punching machines**.

✓ Operation:

They replicate **exactly the same principle** as manual punching machines:

- **A punch.**
- **A die** opposite.
- **And a metal piece** (the hoop) positioned between the two.

But here, **the punch's descent is hydraulic**, which means:

- It is **actuated by a hydraulic jack**.
- **It is controlled by a pedal** at the operator's foot.
- It is powered **by an independent hydraulic unit** (motor + oil pump).

🎯 Workshop Advantages:

- No physical force required.
- Work is more **rapid and fluid**.
- **Stroke adjustment** is possible depending on the metal thickness.
- Ideal for **thick hoops or repetitive production**.



The Punching Machine

03 Punching

Cold Punching

Definition

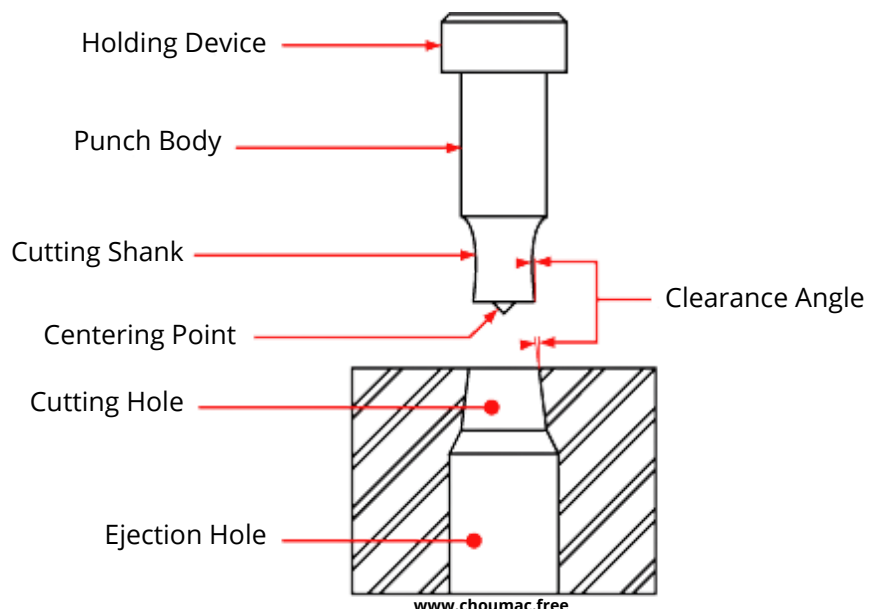
Cold punching consists of **piercing a metal sheet** (feuillard) using a punch, so that it fits into a **die** situated opposite.

This process is performed **without pre-heating** the material.
The cutting is therefore done at **ambient temperature**.

Nature of the work:

It involves a **shearing action**, but in a **closed form**:

- The punch **presses strongly** onto the metal.
- The metal **tears cleanly**, exactly to the shape of the die.
- **The material residue** (called "slug" or carotte) falls into the lower cavity.



The Punching Machine

03 Punching

Punching is a cutting process that consists of **breaking the fibers of the material** to form a hole or a clean cut in a sheet metal.

For this, two tools are used:

- **The punch**, which acts as a moving blade.
- **The die**, which serves as a fixed support and receives the punch.

This process is generally carried **out cold**, meaning without heating the material. It is **very fast** and particularly adapted **to series production**, which is a common choice in the industry for repetitive operations.

However, punching also has its limits. By exceeding **the breaking strength** of the metal over the entire surface of the hole, it creates a significant **work hardening** around the punched area.

🔍 **Work hardening**, also **called strain hardening**, is a phenomenon that occurs when a metal is **plastically deformed cold**. Under the effect of this constraint, its crystalline structure changes, which leads to:

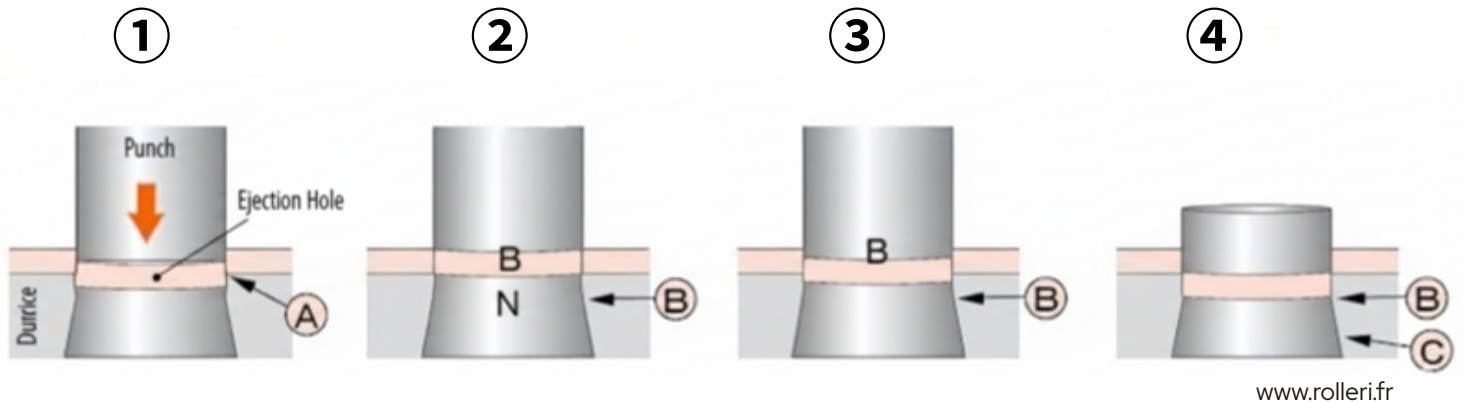
- an **increase in its hardness**,
- a **decrease in its ductility**,
- and an **increased resistance to future deformation**.

🔍 **Ductility** designates the **ability of a material to plastically deform without breaking**. A ductile material can be stretched, folded, or shaped without breaking. It is an essential property in cold forming processes, such as bending (cintrage), rolling (laminage), or deep drawing (emboutissage).

Thus, excessive work hardening can make a piece **brittle or fragile upon re-machining**.

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03 Punching



① The material is sheared (Part A)

The **punch** descends and begins **to shear the material** against **the die**.

A slug forms: this is the drop or washer that will be ejected.

② Compression of the slug (Part B)

During cutting, the slug is compressed, which **slightly deforms it**.

It becomes **a little narrower at this level (zone B)**.

③ The slug is pushed beyond the relief

The punch pushes **the slug beyond a shoulder or a relief** into the evacuation hole.

It descends into the housing without being able to come back up.

④ Mechanical Locking (Part C > Part B)

The compression zone (B) is **narrower** than the **exit (C)**.

Result: the slug **cannot rise again and remains mechanically trapped**, thus ensuring stable and secure ejection.

The Punching Machine

04 Settings

The **clearance** between the punch and the die, that is, the space between the two tools, has a **direct impact on the quality of the punching**, the necessary force, and the life span of the tools.

Types of Clearances:

- **Tight clearance** : about **3 to 6% of the sheet metal thickness**.
- **Wide clearance** : about **10 to 12% of the sheet metal thickness**.

! Effects of a Tight Clearance:

- During impact, a **bulge** forms around the hole due to strong **internal tensions**.
- This generates strong **pressures on the punch**, requiring **more force** to cut.
- The punch is in **permanent contact with the material**, even during its ascent, which significantly increases its **wear**.
- The risk of **slug jamming** is higher, especially due to **vibrations** when the material tears to form the hole.

! Effects of an Overly Wide Clearance:

- **Degraded hole quality** :

The **burr (bourelet)** formed around the hole is more significant. The cut is **less clean**, with a larger tearing zone.

- **Significant burrs** :

The material is no longer cleanly sheared but **torn**, which creates burrs that will need to be **touched up** (deburring).

- **Less precision** :

The punched hole is **less dimensionally precise** and may have **irregular edges**.

- **Less cutting effort** :

The punch penetrates more easily, so the **punching force is reduced**.

- **Less tool wear, but...**

If the tool works "in the void," it is **less mechanically stressed**, but this can favor a **floating clearance** and therefore vibrations, especially on fast presses.

The Punching Machine

04 Settings

✓ For Mild or Galvanized Steel (thickness 1 to 3 mm)

🔧 Simple Rule:

Total Clearance = Sheet Thickness × (8% to 10%)

Clearance per side = Total Clearance ÷ 2

Die Diameter = Punch Diameter + Total Clearance

📄 Example:

Punch: 7 mm **Sheet :** galvanized steel 2 mm

Total Clearance = 2 mm × 0.08 to 0.10 = 0.16 to 0.20 mm

Die = 7 mm + 0.16 to 0.20 mm = 7.16 to 7.20 mm

Sheet Thickness	Total Clearance	Clearance per side
1,0 mm	0,08 to 0,10 mm	0,04 to 0,05 mm
1,5 mm	0,12 to 0,15 mm	0,06 to 0,075 mm
2,0 mm	0,16 to 0,20 mm	0,08 to 0,10 mm
3,0 mm	0,24 to 0,30 mm	0,12 to 0,15 mm

💡 Tips:

- Use the formula to adjust according to your needs.
- For thick galvanized steel, prefer the high value.
- This guide helps you to **prolong the lifespan of your tools and guarantee a clean cut.**

The Punching Machine

04 Setting

🎯 Setting the Depth Stop on a Punching Machine

On a **manual or hydraulic punching machine**, a depth stop is found. This mechanical device allows the position of the hole to be determined with precision.

Its main role:

Allows **centering the hole on the width of the hoop** or the piece to be punched, by fixing a **lateral travel limit**.



The Punching Machine

05 Maintenance

Maintenance of a Manual or Hydraulic Punching Machine

Good maintenance is essential to ensure **the longevity** of the machine, **preserve the cutting quality, and ensure user safety.**

✔ **Operations to perform regularly:**

Cleaning

- Carefully clean the machine after use to prevent the accumulation of shavings or metallic dust.
- Check that no foreign matter hampers the movement of the punch or the die.

Lubrication

- Apply a **drop of oil** or **an adapted lubricating product** on the punch **regularly during use.**
- This reduces friction and wear of the tools.

Checking the Oil Level (for hydraulic punching machines)

- Ensure that the hydraulic oil level is correct.
- Top up or replace the oil according to the manufacturer's recommendations.

Tightening of Elements

- Manual punching machines can **loosen due to vibrations.**
- Regularly check **the tightening of the bolts** and fasteners to prevent any play or misalignment.



The Punching Machine

05 Entretien

Changing the Punch and Die

The replacement of the punch and the die must always be done **in pairs** (tool/die set) in order to ensure **perfect alignment** and avoid premature wear or punching defects.

Steps to follow:

1. Loosening

- Loosen the punch retaining screw.

2. Removal

- Remove **the punch and the die**.
- **Carefully clean** the locations to eliminate residues or shavings.



3. Replacement

- Insert a **new punch and tighten it firmly**.
- Put the **corresponding die** in its housing.

4. Alignment

- Check that **the punch is well centered** in relation to the die.
- Perform a **dry run gently** to ensure good alignment and prevent any breakage.

Good Practices

- Never use a new punch with a worn die (and vice versa).
- Always **work cleanly** to guarantee the lifespan of the tools.
- Check that **the depth stop** is well adjusted after each change if necessary.

The Punching Machine

06 Safety

Safety and Personal Protective Equipment (PPE)

- **Safety footwear** 🦶: Protects against the risks of crushing and falling heavy objects.
- **Anti-noise helmet or earplugs** 🎧: If the punching machine is noisy, especially in series or in a shared workshop.
- **Protective gloves** 🧤: Protect hands from sharp edges, while maintaining good dexterity.
- **Safety glasses** 🕶️: Protect eyes against projections of shavings or lubricant.



Precautions and Adapted Attire

- **Use adapted gloves:** Prioritize tight and specific gloves for the tasks performed. Avoid gloves that are too loose or made of fabric, which risk being caught by the mechanisms.
- **Tie up long hair:** Prevents any risk of entanglement in moving parts.
- **Avoid loose clothing, rings, and bracelets:** Reduce the risks of snagging with moving parts.

Safety Rules for Use

- Always **check that the machine is stopped** before any adjustment or intervention.
- Never **put hands in the pressing zone** while the machine is running.
- Comply **with load and pressure instructions** to avoid any damage to the tooling or projection of parts.
- Use **the integrated safety devices**, such as emergency stop buttons and perimeter guards.

The Punching Machine

06

Sécurité

⚠ Safety During the Use of a Punching Machine

The use of a punching machine, particularly a **hydraulic** one, presents a **risk of crushing** at the punch level and projection of shavings.

🛡 Protection Measures

A **safety plexiglass** is often installed on hydraulic punching machines:

- It allows **viewing the work zone** while **protecting it**.
- **It prevents involuntary access** to the punching zone during the action.

✅ Good Practices

- **Never remove** the safety screen.
- **Keep hands away from** the punching zone.
- **Use a holding tool** if the piece is too small.
- Always **check the alignment and perform a dry run** after each tool change.

*Apply these tips now and take
control of your machine with
confidence and mastery!*



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