They’re some of the most unseen, unsung heroes in a production process. Chains (typically of the metal-pin-and-bushing design) are used throughout industry, primarily for the transmission of power or transfer of goods. Sadly, proper lubrication practices are often disregarded when it comes to these workhorses, leading to shortened chain life and increased costs. Here are some tips to ensure that these critical links keep moving your operations in the direction of profitability.

Internal chain wear can be a killer. You can’t afford to ignore these tips for proper lubrication.

C. David Larson
A. W. Chesterton Co.
The challenges

Poor chain lubrication may be indicated by noise, stiffness or a high rate of what is often referred to as “chain stretch” (i.e., elongation of the chain resulting from internal wear on the pin and bushing). The correct time to replace a chain is frequently overlooked. In many cases, the first notice of wear is when the chain breaks. At this point, the elongation is excessive, leading to additional costs—such as those related to drive-sprocket damage. Stretch or elongation of 2.5% to 3% is generally considered the limit. While chains should be replaced once they reach this limit, often they aren’t. Instead, their tensioning mechanisms might be adjusted or some links removed. These are not true “repairs,” though, as the pins continue to wear. In time, the chain breaks.

You can easily measure the amount of stretch with a chain elongation gauge. This simple tool helps “predict” the optimum time for chain replacement—before collateral damage is done or failure occurs.

Effective lubrication

While there are many causes of chain failure, the most common is internal wear of the pin and bushing—parts that are fit to close tolerances. This is where the chain flexes and also where the load is carried. For all practical purposes, this can be considered as the bearing area of the chain; as such, it needs periodic re-lubrication. In times past, chains were often removed from a machine, solvent-cleaned and placed into a bath of hot oil. While effective, this procedure is generally not practical.

In order to lubricate a chain effectively, the lubricant must have several key properties: The critical requirement is the ability to penetrate to the interior of the chain to lubricate between the pin and bushing. Most chains are relatively static, preventing any possibility of creating a hydrodynamic lubricant layer. To prevent excessive metal contact and wear, the lubrication should possess high film strength. In addition, the lubricant must be able to remove built-up residues from the inside and outside of the chain. For conditions such as water, high temperature or load, the lubricant must have the ability to remain in place and maintain a lubricating film.

Lubrication methods for chains fall into three main categories: Manual, semi-automatic and automatic (see Table I). The size, speed and operating conditions of chains often determine the best application method.

The metal-pin-and-bushing design is the most common chain used in industry, primarily for the transmission of power or transfer of goods.

(CAUTION: The primary wear on a chain occurs when there is relative motion between the pin and bushing. In some applications, this occurs on only a portion of the chain. This is the area that should be checked. An example would be a chain hoist, wherein some of the chain is always in tension and does not experience relative movement. This section would normally see limited wear and should not be the location chosen for elongation measurement.)
More-advanced lubrication approaches may include removal of dirt and dust using mechanical means or a high-pressure air nozzle. Timed application can be made by a precise mist or drops applied to the exact location, maximizing the lubrication, while reducing the amount of lubricant used.

Where to lubricate
Where a chain is lubricated is an important factor in extending its life. The application should be performed before a sprocket or sheave as this is where the chain will flex the most and, thus, assist in the lubricant’s penetration. In situations where a chain is subjected to high temperatures for an extended period—as in ovens, for example—the recommended locations for lubricating are typically before the chain enters the oven and on the return, after it has cooled somewhat. The ideal lubrication point would be between the side plates, given the fact that the lubricant must creep between the plates and along the bushing.

Choice of lubricant
Operating conditions will largely dictate the lubricant choice for a chain. The most common types and/or applications are:

1. Petroleum-based — These economical products are used in applications up to 250 F (120 C).

2. Open-gear — These are tacky, cohesive lubricants used on the surface of open gears. Unlike grease, they don’t squeeze out under pressure. They’re often used together with a petroleum-based internal lubricant on the exterior of chains to protect against surface wear and prevent water washout of the lubricant inside. In severely dusty environments, open-gear lubricants can collect dirt.

3. High-temperature — In operating conditions up to 520 F (270 C), a synthetic lubricant with improved oxidative stability is normally used. These are most commonly based on polyalphaolefins (PAOs), polyalkalene glycols (PAGs) or esters (such as di-ester or polyol ester). The primary considerations are evaporation rate and residue formation at elevated temperatures.

4. Extreme high-temperature — Solid lubricants are usually the only option. They might include:
   - Graphite — 1000 F (540 C)
   - MoS2 — 840 F (450 C)
   - Copper, Nickel, or inorganic powders — up to 2600 F (1425 C)
5. **Incidental food contact** — NSF registered H1 is normally required where there is any possibility of contact with food.

6. **Dry-chain** — In applications where any liquid may contaminate the product, a dry lubricant, such as microscopic PTFE powder, is often used. Experience has shown that up to four times longer chain life is possible with lubrication, compared to no lubrication.

7. **Plastic chain** — These applications could be plastic-to-metal or plastic-to-plastic. Although such chains are frequently promoted as self-lubricated, a silicone-based chain lubricant is often effective.

**Frequency of lubrication**
How often to re-lubricate depends on the chain design, speed and environmental conditions, such as water or temperature. Experience is typically used to determine the lubrication frequency—and is often done when the chain “appears dry.”

On a chain with consistent load, the amperage draw can often be used to judge the correct time for re-lubrication. As it begins to increase, re-lubricating will return the power to the base line. Lubrication frequency can then be set based on this data.

**Strengthening your chain-lube program**
There’s no ideal approach to chain lubrication: It depends on many factors such as chain design, operating conditions and plant constraints. Still, the potential benefits suggest that a comprehensive review of the chain-lubrication practices around your operations would make sense. Typical benefits of an effective program can include improving chain life two to four times; reducing energy consumption by 5 to 10%; and cutting lubricant usage by 50%—while at the same time assuring smooth, reliable operation of your chain system(s). What’s keeping you from moving forward? **MT**

---

*C. David Larson is a business development manager for the A.W. Chesterton Co., located in Groveland, MA. E-mail: larsond@chesterton.com.*