



INSTRUCTIONS

Improved Hardening Technique

Large Tools

- 1a Cut a piece of KNUFOIL from the roll large enough to cover the complete tool with allowance for overlapping by at least 3 inches (75mm). The material can be cut easily with snips or heavy scissors.
- 1b Place the KNUFOIL on a flat, smooth surface and place the tool to be heat-treated in the centre. Carefully draw up the sides of the foil to the top of the tool, taking care not to pierce the foil by pressing too hard against any sharp edges or projections of the tool. Fold over the edges of the foil to make a loose package, but do *not* finally seal.
- 1c Carefully press the foil against the sides of the tool, expelling as much excess air as possible without damaging the foil. Close the top of the package with a further fold of any loose material to make a tight seal. Ensure that the tool is not covered by more than one layer of KNUFOIL.

Small Tools

- 2a The hardening procedure for small tools is best carried out in a purpose made envelope. Cut a piece of foil from the roll, wide enough to be more than double the largest dimension of the tool or part. Fold this piece in half and double fold the sides and bottom, making a simple bag. Place the part or tool into the bag and double seal the top edge by folding over twice.
 - 2b A number of bags of different sizes can be prepared in advance for the handling of small parts.
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- 3. Carefully place the package onto a metal tray and load directly into a hot furnace operating at the recommended temperature for hardening the tool. It is not necessary to pre-heat the material as the foil produces an insulation effect against severe temperature shock.
 - 4. Allow two to three minutes more than the normal hardening time to compensate for the heating of the foil. It may also be necessary to increase the temperature by up to 50°C to compensate for its shielding effects. The exact amount can only be determined by experimenting with the particular metal being used.
 - 5. Remove the hot package in the normal way, taking care not to damage the foil, and quench as quickly as possible. If fast cooling is desirable, it is advisable to use a faster quenching medium to compensate for the shielding properties of KNUFOIL. For example: An oil quench may be used instead of air, or a water quench instead of oil. KNUFOIL usually retards quenching sufficiently to prevent cracking.
 - 6. Remove the tool by cutting the foil with scissors or snips, taking special care to avoid cutting hands on sharp edges. Properly treated tools should be clean, hard and require the minimum, if any, surface finishing. Any discoloration that may occur could be due to leakage during the cooling process, and has little effect on the quality of the hardened tool.
 - 7. Because of the insulation effect of the foil, it is sometimes necessary to remove the foil before quenching in order to obtain a more rapid hardening. This is particularly applicable with small tools, but is simply carried out with the purpose-made bags which can be slit across the top, allowing the tool to fall into the quench immediately.



Tempering

Proceed as for hardening in accordance with the recommendations of the steel manufacturer. Tools which need to be air quenched may be left in the foil package during the tempering operations. Oil quenched tools should be removed from the package prior to this operation.

Venting

Sealed KNUFOIL packages normally expand and contract during use because of the entrapped atmosphere and increasing and decreasing temperatures. With a particularly large or odd shaped tool, a large amount of entrapped air may strain the foil sufficiently for any sharp corners to pierce through the walls of the package. This usually occurs during the cooling and, therefore, it is not generally a serious problem, but it can be completely eliminated by simple venting as follows:

1. Prepare the KNUFOIL package in the normal way and allow one corner to be open by about ¼ inch (7mm). Load the package into the hot furnace, ensuring that the vent remains open. The entrapped air will escape through the vent as the container heats, thus eliminating strains from pressure build-up during the heating cycle.
2. As soon as the package becomes hot, seal the vent by folding it over with a pair of tongs. The tool is then allowed to remain in the furnace until the hardening cycle is completed. The venting procedure also reduces strains during cooling which could result from the rapid collapse of an expanded package.

At temperatures of around 1200°C the foil may adhere or weld to the tool during hardening. A simple alternative venting procedure will eliminate this problem as follows:

To harden high speed steel at high temperature, allow the vent to remain open during the whole of the heating cycle. Immediately prior to quenching, close the vent and then oil quench.

Important Precautions

At high temperatures the material becomes very soft and must be handled particularly carefully to avoid damage. If necessary, a double wrap of foil can be used to ensure that the tool is adequately protected. However, a slight additional increase would have to be made to the hardening times. It is not recommended to take the material above 1200°C.

It is strongly recommended, before using this material for the first time, that a limited amount of experimental work be undertaken in order to obtain the best results. The enclosure of a small piece of Titanium strip in the foil bag will ensure complete freedom from oxidization. This is not usually necessary, except for very precise and delicate tools.

Further Applications

Small parts can be successfully bright hardened if effectively sealed in a foil bag and will also be free of oil stains. To obtain maximum brightness the parts must be thoroughly cleaned before the heat treatment. They should then be carefully loaded onto the foil and a secure package made with several extra folds to ensure that the parts do not pierce the foil. It is essential, however, that there is a rapid transfer of the package of small parts from the furnace to the quenching medium in order to get the best results.

Annealing

The protective properties of KNUFOIL are ideally suited for annealing. Wrap the parts or tool with KNUFOIL and, using standard procedure, follow the normal annealing cycle.

