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Phillips**

**ACCO Brands
Exhibit 1005**

ACCO Brands v. Think Products
IPR2015-01167

To my sons, Daniel and Michael

FIRST EDITION
THIRD PRINTING

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Published by TAB Books.
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Library of Congress Cataloging-in-Publication Data

Phillips, Bill, 1960-
Professional locksmithing techniques / by Bill Phillips.
p. cm.
Includes index.
ISBN 0-8306-7523-X (h) ISBN 0-8306-3523-8 (p)
1. Locksmithing. I. Title.
TS520.P55 1990
683'.3—dc20 90-47231
CIP

Acquisitions Editor: Kimberly Tabor
Book Editor: Cherie R. Blazer
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Book Design: Jaclyn J. Boone

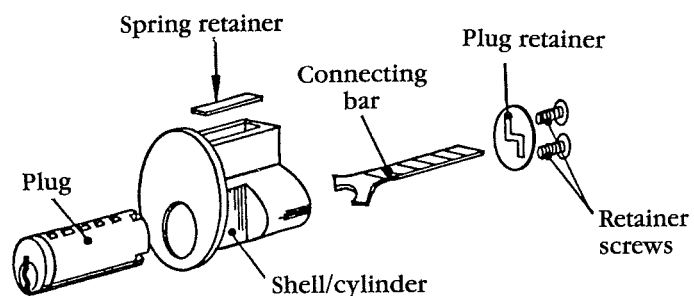
Chapter 5

Pin tumbler locks

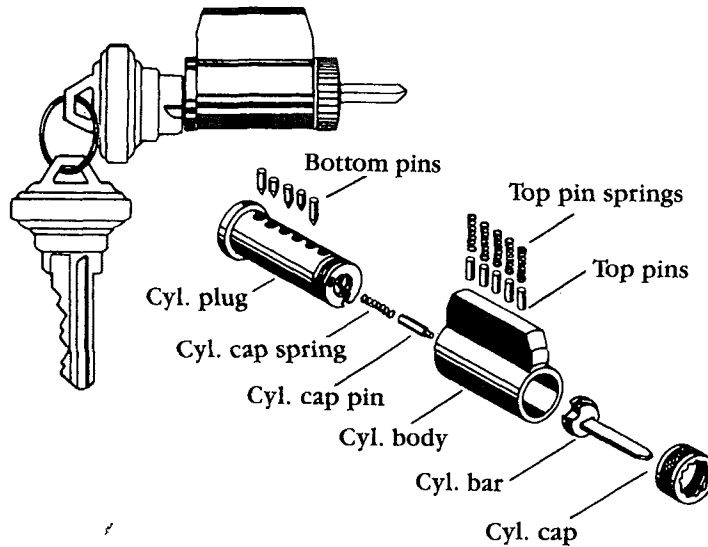
A pin tumbler lock is any lock that has a pin tumbler cylinder. The pin tumbler cylinder is the most popular type of cylinder in use today. It is used in key-in-knob locks, deadbolt locks, rim locks, padlocks, and automobile locks.

The basic parts of a pin tumbler cylinder for rim and mortise locks include the following: cylinder case (or shell or housing or body), plug (or core), keyway, upper pin chambers, lower pin chambers, springs, top pins (or drivers), and bottom pins (FIG. 5-1). Pin tumbler cylinders for key-in-knob locks have a few extra parts (FIG. 5-2).

The cylinder case houses the other basic parts. The plug rotates when the proper key is inserted into it. The keyway is an opening in the plug that accepts the key. The drilled holes (usually five or six) across the length of the plug are lower pin chambers that each hold a bottom pin. The corresponding drilled holes in the cylinder case directly above the plug are upper pin chambers that each hold a spring and a top pin.



5-1 Partially exploded view of a pin tumbler cylinder for a rim lock.



5-2 Exploded view of a pin tumbler cylinder for a key-in-knob lock.
courtesy Schlage Lock Company

OPERATION

The downward pressure of the springs drive the top pins down into the plug until they rest on the bottom pins. When a top pin is partially in an upper pin chamber and partially in a lower pin chamber, it prevents the plug from being rotated.

There's a small amount of space between the plug and the cylinder case. This space is called a *shear line*. Without a shear line, the plug could never be rotated, because it would fit too tightly in the cylinder case. When the right key is inserted into a pin tumbler lock, it lifts the bottom pins to the shear line, which causes the top pins to also be at the shear line. Figure 5-3 illustrates how the right key aligns the pins to the shear line.

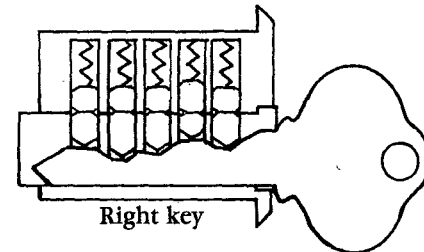
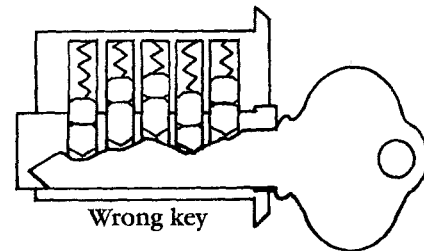
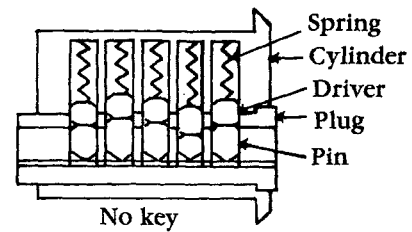
When all the pins are at that position, the plug is free to rotate into the locked or unlocked position. While the plug is rotating, the lower pin chambers separate from the upper pin chambers. The top pins then rest on top of the plug (FIG. 5-4).

Usually all the top pins in a cylinder are the same height, but the bottom pins vary in length. In no case, however, is a bottom pin long enough to protrude into an upper pin chamber when no key is in the keyway. The key cuts can only lift the pins up, not pull them down. The depth of the cuts in a key must correspond to the depths of the bottom pins for the key to operate the lock.

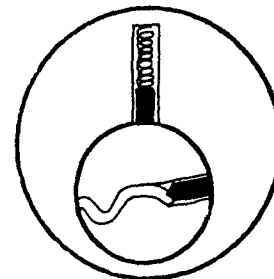
REMOVING A BROKEN KEY

Sometimes you might need to remove a piece of broken key from the plug of a pin tumbler lock. One way to accomplish this is to insert a thin

5-3 The right key aligns the top and bottom pins to the shear line so the plug is free to rotate.



5-4 When the plug is rotated, the top pins rest on its surface.

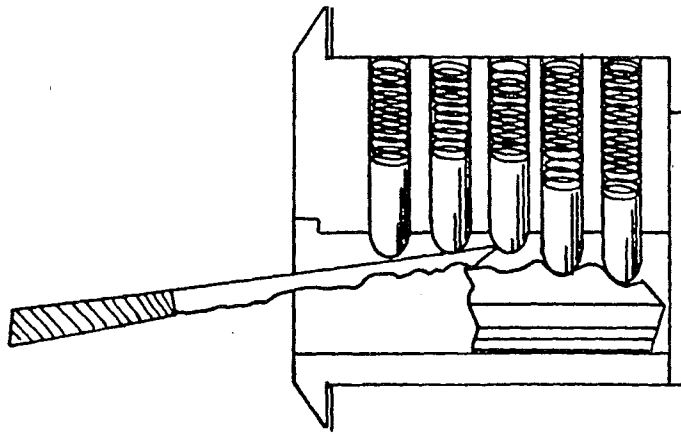


hooked piece of wire into the keyway, hook pointing down, and catch the end of the broken key (FIG. 5-5). Sometimes it's easier to use a thin saw blade to poke the broken key and manipulate it out of the plug (FIG. 5-6).

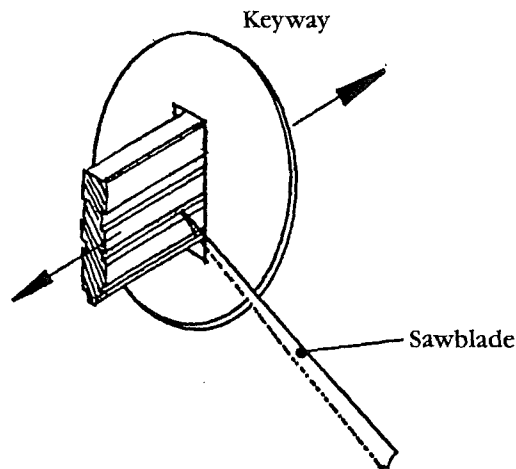
If part of the broken key is protruding out of the plug, you might be able to use a pair of pliers to pull it out. Locksmith supply houses sell a wide variety of broken key extractor tools.

REKEYING

To rekey a pin tumbler cylinder, first remove the device retaining the plug—which will be a retainer clip, cam, or cylinder cap. The device varies among different pin tumbler cylinders.



5-5 A thin hooked tool can be used to remove a piece of broken key from a cylinder.



5-6 Sometimes a saw blade can be used to manipulate a piece of broken key out of a cylinder.

A retainer clip can be removed by prying it off with a small screwdriver. A cam can be removed by unscrewing the two small screws holding it in place.

To remove a cylinder cap (found on key-in-knob locks), depress the cap pin with an awl or edge of a small screwdriver, then rotate the cap counterclockwise until it comes off (FIG. 5-7). Remove both the cap pin and the small spring beneath it from the plug.

Rotate the plug about 15 degrees clockwise or counterclockwise. The easiest way to do this is by using a key. If no key is available, you'll need to pick or shim the lock. Be sure not to pull the plug forward while rotating it.

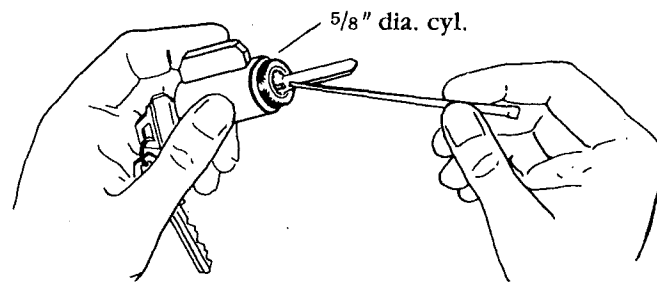
Now hold a plug follower or following bar firmly against the back of the plug (FIG. 5-8). Push the tool through the cylinder body. Make sure the

plug follower is in constant contact with the back of the plug; if the plug and plug follower separate too soon, the top pins and springs will fall out of the upper pin chambers.

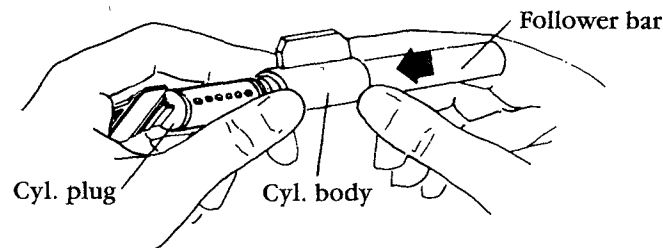
After the plug is pushed out of the cylinder body, set the cylinder body aside and set the plug into a plug holder, sometimes called a holding fixture (FIG. 5-9). It isn't essential to use a plug holder, but using one makes rekeying cylinders easier.

Remove the pins from the plug. Insert a new key. Then add appropriate size pins into the plug. Use bottom pins that reach the shear line of the plug with the new key in place. Figure 5-10 shows how the pins should be aligned.

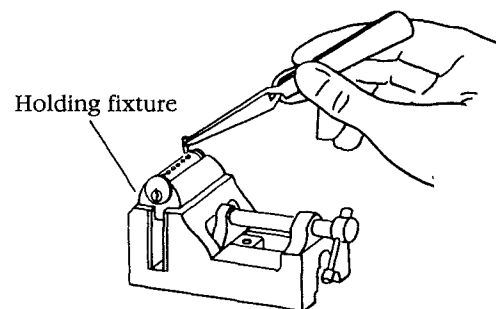
There are three ways you can find the correct pins to use. One is by comparing the key biting numbers written on the bows of some factory original keys to the cross-reference charts listed on most key pinning kits.



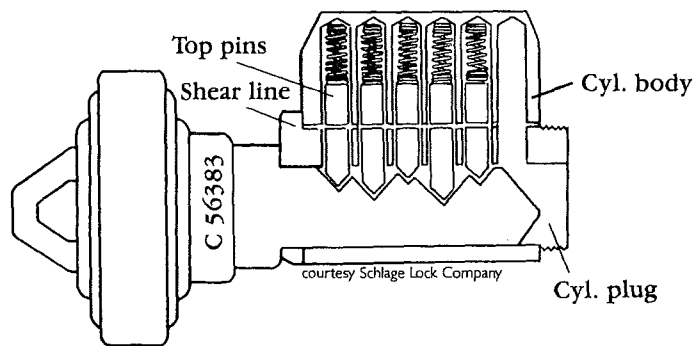
5-7 Depress the cylinder cap pin and rotate the cylinder cap counterclockwise to remove the cap. Schlage Lock Company



5-8 Use a plug follower to hold the springs and top pins in place while removing the plug. Schlage Lock Company



5-9 A plug holder can be used to hold the plug you're working on. Schlage Lock Company



5-10 When a properly cut key is inserted into a cylinder, all the pins are raised to the shear line.

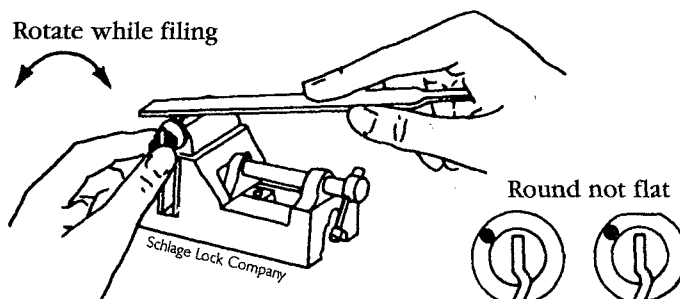
If the key doesn't have such a number you can use a key gauge or a caliper to measure the cuts of the key, then compare your readings with the information listed on your key pinning kit.

Another way to find the right pins is by trial and error. Look at the key and compare the depths of the cuts to one another. The deeper the cut in the key, the longer the pin for that cut must be. After finding the right pin for the first cut, use the size of that pin as a reference point for locating the other sizes you need.

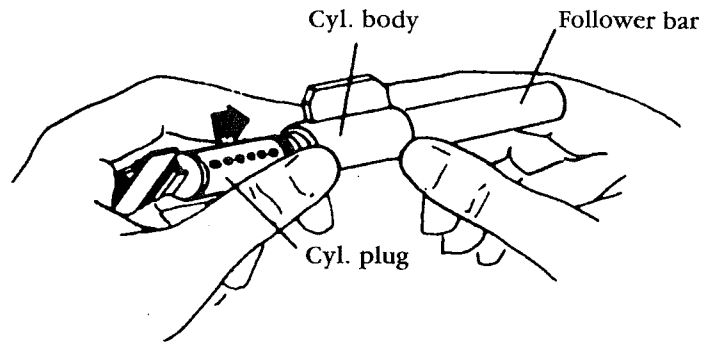
Ideally, you should find pins that fit perfectly in the plug. In an emergency, you might want to use bottom pins that are too long and file them down with a fine mill file. Be sure to use the key to rotate the plug while filing, so you don't flatten the top of the plug (FIG. 5-11). Most locksmiths consider it unprofessional to file pins down.

After fitting the pins to the plug, insert the plug into the face of the cylinder body. Push the back of the plug against the plug follower until the tool comes out of the cylinder (FIG. 5-12). Do not allow the plug and the plug follower to separate from each other.

Hold the plug and cylinder body so the plug doesn't slip out of the body, and test the new key. Make sure the plug rotates easily and the key smoothly slides in and out of the plug (FIG. 5-13). If there is a problem at



5-11 When filing pins, don't file the plug.



5-12 Push the plug against the plug follower. Schlage Lock Company

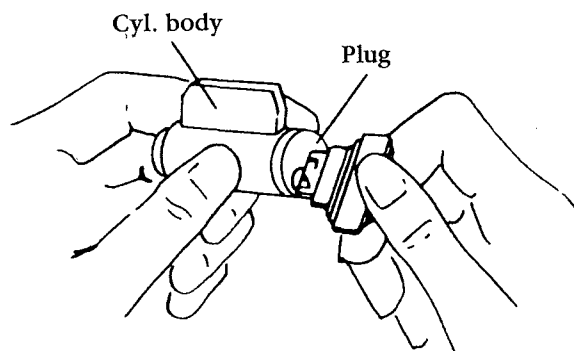
this point, use the plug follower to remove the plug, and check the heights of the pins. Then put the plug back into the housing and test the key again.

After the key is working properly with the plug in the cylinder body, slowly remove the key. Don't pull hard enough for the plug to slip out of the cylinder body. Then reassemble the cylinder by reversing the procedure you used to disassemble it (FIG. 5-14).

REPLACING TOP PINS

Many locksmiths purposely remove the springs and top pins every time they rekey locks. This allows the locksmith to clean the upper pin chambers and to replace any worn or broken top pins.

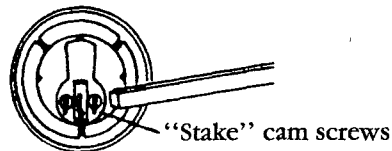
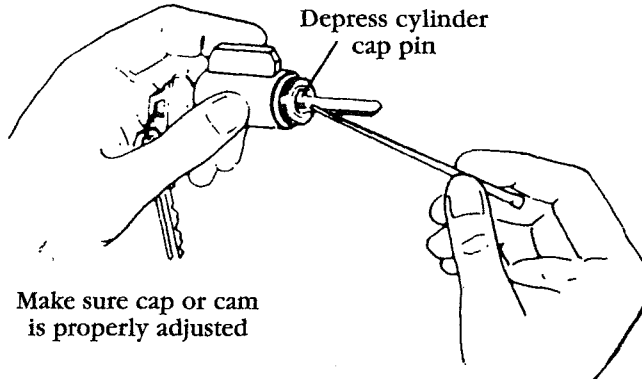
To reload the upper pin chambers, use a pair of tweezers or similar device to hold pins. With this device and a plug follower, you can easily replace the springs and top pins (FIG. 5-15). However, it takes a little practice. The first time you try loading upper pin chambers, you'll probably frequently drop pins and springs.



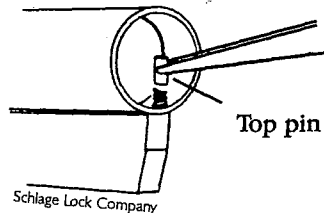
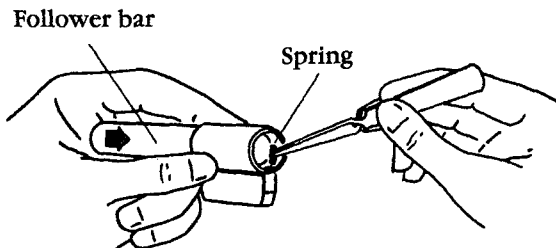
5-13 Test the new key after rekeying a cylinder. Schlage Lock Company

TUBULAR KEY LOCKS

The tubular key lock is basically a pin tumbler lock that has its tumblers arranged in a circle. Like any other pin tumbler lock, it has springs, top pins, and bottom pins. The tubular key has notches of varying sizes to correspond to the lengths of the pins. When the key is inserted into the keyway, it pushes the pins to the shear line so the plug can rotate.



5-14 Put the retaining device back in place after rekeying the cylinder. Schlage Lock Company



5-15 It takes a little practice to feel comfortable replacing springs and top pins.