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TRAILER KINGPIN LOCKS - FINAL REPORT

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FINAL REPORT

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1.0 INTRODUCTION

In support of the ongoing effort of the Department of Transportation to develop recommendations for the prevention of cargo theft utilizing available technology, the Office of Systems Engineering, DOT, sponsored an examination and evaluation of typical trailer kingpin locking devices. This evaluation was designed to determine the degree of protection provided by commercially available devices, to develop criteria for evaluating such devices, and to make recommendations for improvements which would make such devices more effective. This report contains the results of that examination and evaluation.

In the description and evaluation of the individual devices trade names of typical locks and cylinders are used. This does not imply recommendation or condemnation of these components but is intended to indicate the general type of such components without the necessity for a detailed description.

2.0 SUMMARY OF EVALUATION

Eight different models of trailer kingpin locking devices, manufactured by five different companies, were examined. All designs were found suitable for temporary protection of a loaded trailer in a supervised working area. Only the improved Best Lock Company Model 2J7D21 was found suitable when used as a component of a comprehensive security plan for extended protection in a storage area subject to only occasional supervision. All locking device designs were such that they could be made suitable for extended protection by simple mechanical design modifications. Detailed recommendations are made of desirable improvements for each locking device design. A list of recommended design features suitable to trailer kingpin locks in general is included as Section 7.0.

3.0 APPLICATION OF TRAILER KINGPIN LOCKING DEVICES

3.1 General Description

A trailer kingpin locking device consists of a collar or other obstructive device which is attached to the "fifth wheel" pivot pin of a motor freight semi-trailer when the trailer is parked and detached from its tractor truck. The locking device incorporates a lock cylinder or padlock intended to prevent unauthorized removal and is designed to prevent attachment of a tractor truck to the trailer on which it is installed.

3.2 Applications

Trailer kingpin locking devices are used to prevent or deter the removal of a, usually loaded, semi-trailer when it is parked for loading, unloading, or temporary holdover. There are two typical use applications of these devices.

The first application is to prevent the quick surreptitious removal of a loaded trailer parked at a loading dock or other area accessible to the street while the attention of company employees is momentarily diverted. The requirements for a device suitable for this application are relatively simple.

The second application is to prevent or deter the unauthorized removal of a trailer and cargo parked for a period of time in a controlled area which is not under regular or constant surveillance. The requirements for a device suitable for this application are quite severe. It must resist picking of the lock cylinder, as well as

force applied to the lock cylinder and forcing or manipulation of the locking bolts of the device.

4.0 METHOD OF EVALUATION

Eight different models of locking devices representing the designs of five different manufacturers were obtained. They were examined, checked and laboratory tested for resistance to picking, minor forcing and manipulation by a skilled locksmith. The physical construction of each device was evaluated as to its convenience in use, the probability of the device being improperly attached to the trailer kingpin either by accident or design, and the resistance of the device locking bolt to forcible attack. The locking cylinders or padlocks were examined and tested to determine their resistance to picking, forced operation (forcing), drilling, by-passing, and forcible removal (pulling). The manufacturing tolerances and design of each device were examined to determine the resistance of the device to manipulation (by-passing). During the course of this examination correctable weaknesses of each device were noted and recommendations for improvement to enhance its security were prepared.

These relatively cursory examinations were limited to the security aspects of the devices as determinable in the laboratory. Field tests of the devices in the environment typical of truck terminal use, especially under adverse weather conditions, were not conducted. Such tests are recommended to detect hidden weaknesses, especially defects that could be caused by dirt, water, ice and corrosion.

5.0 DESCRIPTION AND EVALUATION OF INDIVIDUAL DEVICES

5.1 Trailok Model 2601 and Model 2602, Manufactured by Otto Industries, Cranford, New Jersey

5.1.1 Description

This device (Figure 1) consists of a six inch diameter circular machined steel collar which fits closely over the trailer kingpin. A locking cylinder fits within this collar and operates a heavy (one inch diameter) dead bolt to secure the collar to the kingpin. The two models differ only in the lock cylinder used; Model 2601 has a flat disc tumbler type key cylinder and Model 2602 has a round Ace (Chicago Lock Company) key cylinder. There is no cylinder cover to prevent pulling or drilling of the cylinder core. The Model 2602 with the Ace lock is superior in this respect because the cylinder is more difficult to drill with a conventional solid shaft twist drill and to obtain purchase of a pulling tool. The set screw that retains the lock cylinder is accessible from one face of the collar and could be attacked if the device were installed upside down. The opening at the bottom of the collar provides an opportunity for attack of the lock bolt or the kingpin flange.

Both types of lock cylinders used are of fair quality but both can be picked by a semi-skilled person.

5.1.2 Evaluation

This device provides protection against rapid surreptitious removal but is not suitable in its present configuration for protection of an unguarded trailer for an extended period of time.



FIGURE 1
TRAILOK MODEL 2602

This device could be modified to provide a higher degree of protection by a change to a closed bottom, which will protect against improper installation and attack on the bolt or kingpin flange, and by use of a more pick- and force-resistant cylinder. Addition of a second bolt and cylinder would further increase security by increasing resistance to wedging or rocking of the device.

5.2 American Trailer Lock, Model KPH with Model H.10 Padlock, Manufactured by American Lock Company, Chicago, Illinois

5.2.1 Description

This device (Figure 2) consists of a cast steel "D" shaped collar with two internal retaining levers which clamp on the trailer kingpin and are secured by a padlock. The bottom of the device has an opening smaller than the trailer kingpin flange diameter so the device cannot be installed upside down. The retaining levers are accessible, but with difficulty, to attack through the side padlock opening or through the bottom.

The security of the device is severely limited by the padlock used. The Model H.10 padlock furnished with the device is a standard heavy duty padlock but cannot be considered a true security lock as its cylinder is quite vulnerable to forcing, drilling, pulling and picking, and the shackle is also vulnerable to simple force techniques.

5.2.2 Evaluation

This device provides protection against rapid surreptitious removal but is not suitable in its present configuration, with the



FIGURE 2
AMERICAN TRAILER LOCK MODEL KPH

padlock supplied, for protection of an unguarded trailer for an extended period.

Use of a higher security padlock would greatly improve the effectiveness of this device. Closing the bottom opening and modifying the side opening to be completely filled by the body of the padlock would correct the remaining apparent weaknesses.

5.3 American Trailer Lock Model KPC, Manufactured by American Lock Co., Chicago, Illinois

5.3.1 Description

This device (Figure 3) consists of a cast steel collar open at both ends which fits closely over the trailer kingpin. A pin tumbler locking cylinder fits within this collar and operates a heavy dead bolt to secure the collar to the kingpin. This is a sliding rectangular bolt one inch by two inches in cross section with the locking face concave to match the kingpin contour. There is no cylinder cover protection and the cylinder can be pulled or drilled. The cylinder is retained by two set screws inserted through the side of the collar with the holes filled by soft metal or metal-epoxy plastic backed by a wood dowel. The set screws can be attacked by someone knowledgeable of their location. The bolt or trailer kingpin flange can be attacked with difficulty through the opening in the face of the collar. The hole in the lower face is smaller than the kingpin flange to prevent installation upside down. The lock cylinder is of fair quality but can be easily picked by a semi-skilled person.



FIGURE 3
AMERICAN TRAILER LOCK MODEL KPC

5.3.2 Evaluation

This device provides protection against rapid surreptitious removal but is not suitable in its present configuration for protection of an unguarded trailer for an extended period of time. The concave face rectangular locking bolt provides moderate protection against wedging or rocking.

This device could be modified to provide a high degree of protection by closing one end, retaining the cylinder by set screws accessible only from the protected surfaces of the device, adding a cylinder cover to prevent pulling, using a more pick- and drill-resistant cylinder and using heavier set screws on the locking cam.

5.4 Hansen Gard Lok, Manufactured by Hansen Lock Company, Gurnee, Illinois

5.4.1 Description

This device (Figure 4) consists of a cast steel hinged collar which clamps around the trailer kingpin. The collar is open at both ends but because the key must be used to lock the device it cannot be installed upside down. The hinge pin is heavy steel but could be attacked. The collar is secured in the closed position by a round high tensile strength steel locking bolt. This bolt is guarded by a shallow rectangular mortice which is intended to protect it from attack. The lock cylinder is inserted into the lower face of the device and a removable carrying handle is attached to facilitate proper application. The device uses a "Gem" round key cylinder



FIGURE 4
HANSEN GARD LOK

(similar to the "Ace" cylinder in outward appearance) which is somewhat resistant to ordinary drills and pulling techniques. It can be easily picked by a semi-skilled operator. The clamp type of design makes this device resistant to wedging or rocking. The open bottom and the space between the two halves of the device are accessible to attack as is the trailer kingpin flange.

5.4.2 Evaluation

This device provides protection against rapid surreptitious removal but is not suitable in its present configuration for protection of an unguarded trailer for an extended period of time.

This device could be modified to provide a higher degree of security by adding an overlapping bottom plate which would cover the bottom opening to the trailer kingpin and the lower end of the device hinge pin. Closer tolerance of matching parts and a better overlapping closure to better protect the latch bolt are desirable. Change to a pick-resistant type of cylinder protected against pulling or drilling would correct the remaining apparent weaknesses of this device.

5.5 Best Trailer Pin Lock, Model 2J7L1 and Improved Model 2J7D21, Manufactured by Best Lock Company, Indianapolis, Indiana

5.5.1 Description

These devices (Figure 5) are mechanically similar and differ only in the locking bolt arrangement and cylinder protection. The device consists of a steel weldment with a collar to contain the trailer kingpin and two rectangular steel ears each containing a lock cylinder



FIGURE 5
BEST TRAILER PIN LOCK MODEL 2J7D21

and round locking bolt. In the original lock (Model 2J7L1) the locking bolts are spring loaded and snap on the kingpin, this makes the device vulnerable to rapping, wedging and rocking. The device has a closed bottom to protect the locking bolts and the kingpin flange. To remove the lock both cylinders must be unlocked to rotate the locking bolts. The seven mushroom head pin tumbler cylinders are very resistant to picking but in the original model are vulnerable to drilling and pulling. The cylinders are retained by roll pins accessible only from the top and thus are protected when the lock is in place.

The two cylinders may be keyed alike or differently as required by the security system of the user.

The improved device (Model 2J7D21) has a dead lock position for the two bolts and must be locked in place on installation. The cylinder is protected against drilling or pulling by a protective cover and key slot plate.

The Best Lock Company also manufactures a single cylinder device which is not as secure as the two examined.

5.5.2 Evaluation

The original Model 2J7L1 lock and the single cylinder Best locks are only suitable for protection against rapid surreptitious removal.

The improved Model 2J7D21 lock, especially when equipped with mushroom head pins, is a high security trailer pin locking device. As with any locking device, it can be defeated by the use of power tools and/or access for an extended period of time. It can be

recommended for protecting a loaded trailer against removal from areas subject to only general or occasional surveillance.

5.6 Silent Guard Trailer Lock, Manufactured by States Products, Inc., Minneapolis, Minnesota

5.6.1 Description

This device (Figure 6) consists of a circular cast aluminum alloy collar open at both ends which fits over the trailer kingpin. The device is retained in place by a one inch by three inch locking bolt having a concave face to match the kingpin contour. This locking bolt is part of a locking drawer containing the lock cylinder. This drawer is protected by a drill resistant steel liner in the device housing. The device may be disassembled by removing four cap screws accessible on the upper face of the lock. If the lock is installed upside down, these screws may be removed and the lock defeated. The device has a carrying handle for ease of handling.

The cylinder uses a half-round "Abloy" key and is pick resistant. It may be forced, but only with the use of special tools, and it is resistant to pulling. The lock bolt and kingpin flange are vulnerable to attack through the open bottom and cracks between the separate elements of the housing.

5.6.2 Evaluation

This device provides protection against rapid surreptitious removal but is not suitable in its present configuration for protection of an unguarded trailer for an extended period of time.



FIGURE 6
SILENT GUARD TRAILER LOCK

The device could be modified to provide a higher degree of security by changing to a closed bottom housing and tightening of tolerances around the locking drawer to prevent access for manipulation.

6.0 CONCLUSIONS

The following conclusions were reached as a result of the examination of these trailer kingpin locks:

a. All locking devices examined were suitable for temporary protection of a loaded trailer against rapid surreptitious removal from an active or a guarded area.

b. All but one of these devices could be defeated in less than one minute by a semi-skilled operator employing the simple technique appropriate to each device.

c. Only the improved Best lock (Model 2J7D21) is suitable for extended protection of a loaded trailer against removal when stored in an area subject to general or occasional surveillance.

d. All designs of locking devices examined were basically sound and could be improved to a much higher state of security by simple modifications well within the present state-of-the-art.

e. Certain common features were found to be necessary to any design of trailer kingpin locking device to provide a high degree of security. These are enumerated in Section 7 of this report.

f. The degree of protection provided by these devices, even with the incorporation of the desired improvements, is not absolute. They can when properly designed and constructed provide sufficient protection so that the effort, time, and exposure necessary for their defeat is equivalent to that necessary to break open the trailer and transfer its load.

g. These devices are to be considered as a supplement to, rather than a replacement for, proper supervision of parked loaded trailers.

h. Where these devices are used the keys and the locks themselves should be strictly controlled to prevent unauthorized persons having access to or obtaining duplicates for the trailer lock keys or substituting a rigged locking device in place of the legitimate one.

7.0 RECOMMENDED DESIGN FEATURES

It is recommended that trailer kingpin locks which are to be used to provide protection for an extended period of time have at least the following features:

- a. A heavy collar with an enclosed bottom to protect against forcible attack of the kingpin flange or the locking bolts.
- b. An enclosed bottom to provide positive assurance against installation upside down.
- c. A concave-faced locking bolt or clamp bearing against a large segment of the kingpin, or use of multiple locking bolts to provide adequate bearing strength and protection against wedging and backing.
- d. A highly pick-, force- and drill-resistant cylinder.
- e. Protection against drilling and pulling of the cylinder, either in the cylinder design, in its retaining means, or by providing a secure cylinder cover.
- f. All retaining screws accessible only from the top or interior of the locking device.
- g. Close tolerances of matching parts to protect against manipulation and bypassing of the locking means.
- h. A high security padlock which conforms to specification MIL-P-43607, Padlocks, High Security, Key Operated, where a padlock is the securing mechanism of a kingpin lock.

END