A method to determine the performance of plastic lock and latch sets at elevated temperatures

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PREPARED FOR C. G. S. B. Committee on Lock and Latch Sets

SUBJECT A METHOD TO DETERMINE THE PERFORMANCE OF PLASTIC LOCK AND LATCH SETS AT ELEVATED TEMPERATURES

In connection with the drafting of a new standard (69-GP-16) for plastic lock and latch sets the Committee on Lock and Latch Sets of the Canadian Government Specifications Board has requested the Division of Building Research, NRC to evaluate requirements for their performance under fire conditions. A criterion for this performance is the ability to remain operative at elevated temperatures for a sufficient length of time to allow escape of occupants from the fire area. In order to find a suitable test procedure for determining the thermal performance of plastic lock and latch sets, tests have been carried out on two types of lock sets that were available.

SURVIVAL TEMPERATURES

Studies [1] show that survival of humans exposed to elevated temperatures, depends to a high degree on the ambient air temperature and the time of exposure. In general the higher the temperature the shorter the tolerance time. This time decreases progressively with increasing temperature.

In addition to air temperature and exposure time, other factors that affect the chance of surviving exposure to heat are the type and thickness of clothing that protects the occupants, their state of health, and the humidity of the ambient air. All these factors can vary in a wide range and therefore it is not possible to indicate a specific temperature as survival temperature.

Results of studies, described in references 1-3, suggest, however, that the chance of surviving exposure to temperatures of more than 300°F for 10 minutes or longer is remote. Therefore, exposure to temperatures of 300°F for 10 minutes, which may be considered as representing the maximum survivable condition, has been selected as test condition for investigating the thermal performance of plastic lock and latch sets.

TEST APPARATUS

The heat exposure tests were carried out with the aid of a laboratory oven, (CENCO Catalogue #95379-16), circulating air type (see Fig. 1). The opening of the oven was approximately 16 in. wide and 18 in. high. A wooden frame, in which a test specimen of 1-3/4 in. thickness was mounted, could be attached to the test oven. The frame was made from standard 2-in. by 4-in. pine and had a 1/2-in. stop. The opening for the test specimen, which consisted of a door element in which a latch set was installed, was 16-3/4 in. wide and 15-5/8 in. high.

During the test the door was hinged so as to open into the oven and the latch set and strike were mounted accordingly. The frame itself was hinged to the furnace in order that it could be swung open to allow operation of the latch set by the exposed knob (Fig. 2).

In order to simulate the forces that would be applied to the latch set in the event of the door warping, and to ensure that the bolt was held in contact with the strike, a compression spring was positioned on the unexposed face of the door between the knob and the frame (see Fig. 3). Contact between bolt and strike was regarded necessary from the point of view that the heat conducted through a metal strike might melt a groove in the latch and thus prevent its movement. The force applied by the spring could be varied by adjusting its length. During the test, a force of 40 lb (176 N) was applied to the door.

The oven temperature was measured by a thermocouple positioned approximately 1/2 in. (1.25 cm) away from the centre of the face of the exposed knob. Although there are other methods to install the thermocouple, a convenient way is to pass it through a hole in the face of the door and fasten it to the inner face of the door by staples or other means. The wire should be of sufficient thickness (20 ga or approximately 1 mm) to allow it to be positioned as described above.

Control of the oven temperature can be accomplished by the control system provided by the manufacturer. The air circulation system of the oven provided reasonably uniform temperatures throughout the oven.

TEST SPECIMENS

Two types of plastic lock and latch sets, which were representative of existing sets, were chosen for testing (see Fig. 4):

Type 1 - The latch bolt is located in the door edge (Fig. 4a). The strike is made of metal.

Type 2 - The latch mechanism is in the door jamb (Fig. 4b).

TEST PROCEDURE

A baffle or substitute panel should be placed in the opening in order to preheat the oven to the desired temperature. After reaching this temperature the baffle is removed and the test frame and specimen swung into position in order to expose the lock set to the heat of the oven. It will be found that, due to heat loss to the surroundings during the exchange of the baffle for the test specimen, the oven temperature drops for a few moments. The oven used was able to recover quite rapidly and the actual test was started at the moment that the temperature measured near the knob reached the selected test temperature of 300°F. The oven temperature was controlled by adjusting the heat input into the oven with the aid of the controlling system that was installed in the oven. Heating of the specimen at 300°F continued for a time period of 10 minutes. Immediately after this the test frame was swung open and the lock set was operated. To obtain an idea of the torque that is required to turn the knob a torque wrench was used to open the door. The wrench was connected to the unexposed knob by means of a brass insert, which replaced the original rosette and transmitted the torque to the knob (Fig. 5).

RESULTS AND CONCLUSIONS

Two tests were carried out, one on each type of latch and lock set. During the test one side of the set was exposed to the heat of an oven at 300°F for 10 minutes. This condition was regarded as the maximum survivable condition for occupants of buildings exposed to the heat of fire.

The specimens tested under this condition performed satisfactorily. The torque necessary to open the door was about 10 inch-pounds, which was well below the limit of 30 inch-pounds prescribed in the 69-GP-16 standard for room temperatures. In a standard test, to simulate the actual way of opening the door, it is suggested to operate the lock set manually by means of the heat exposed knob.

The test method described above was purposely kept as simple as possible, but it is expected to give sufficient information on the performance of a lock or latch set exposed to maximum survivable heat conditions.

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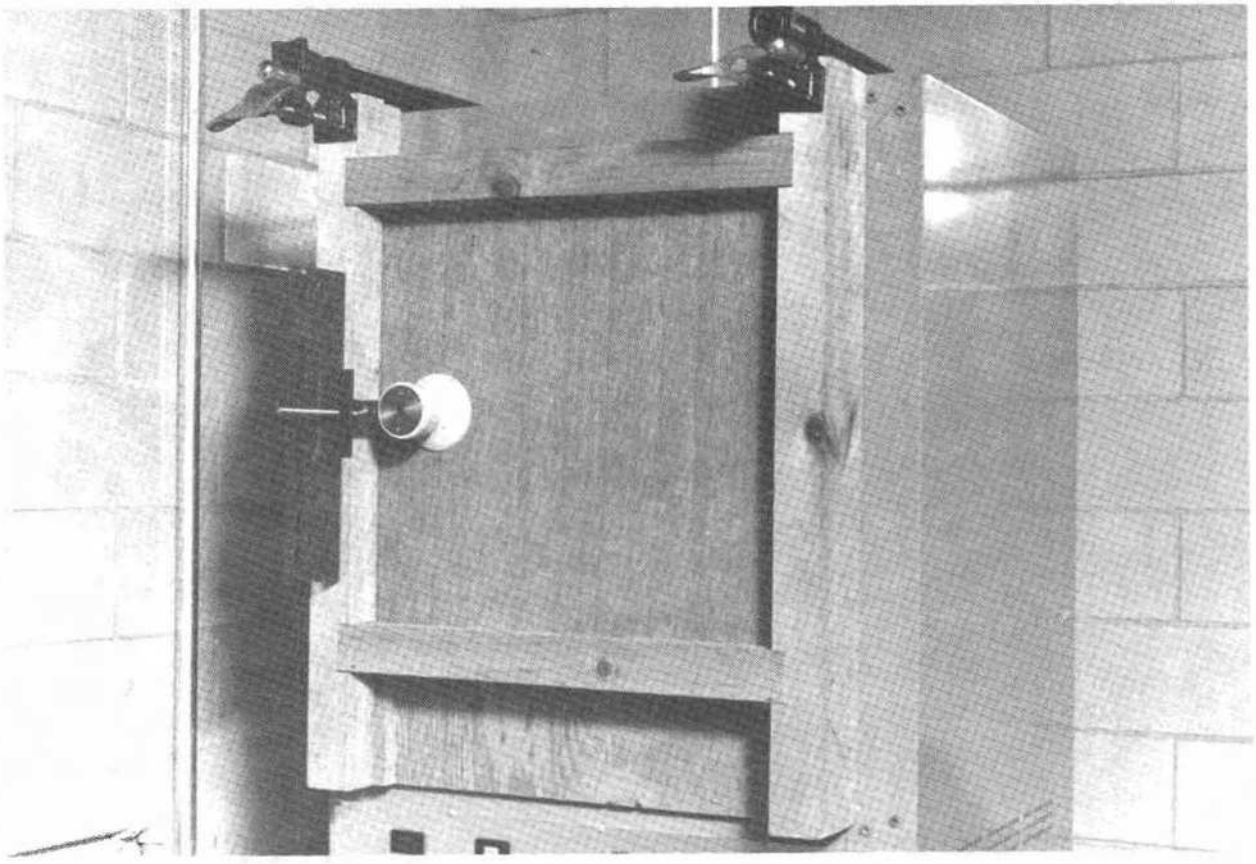

Figure 1

Test Oven and Door Assembly

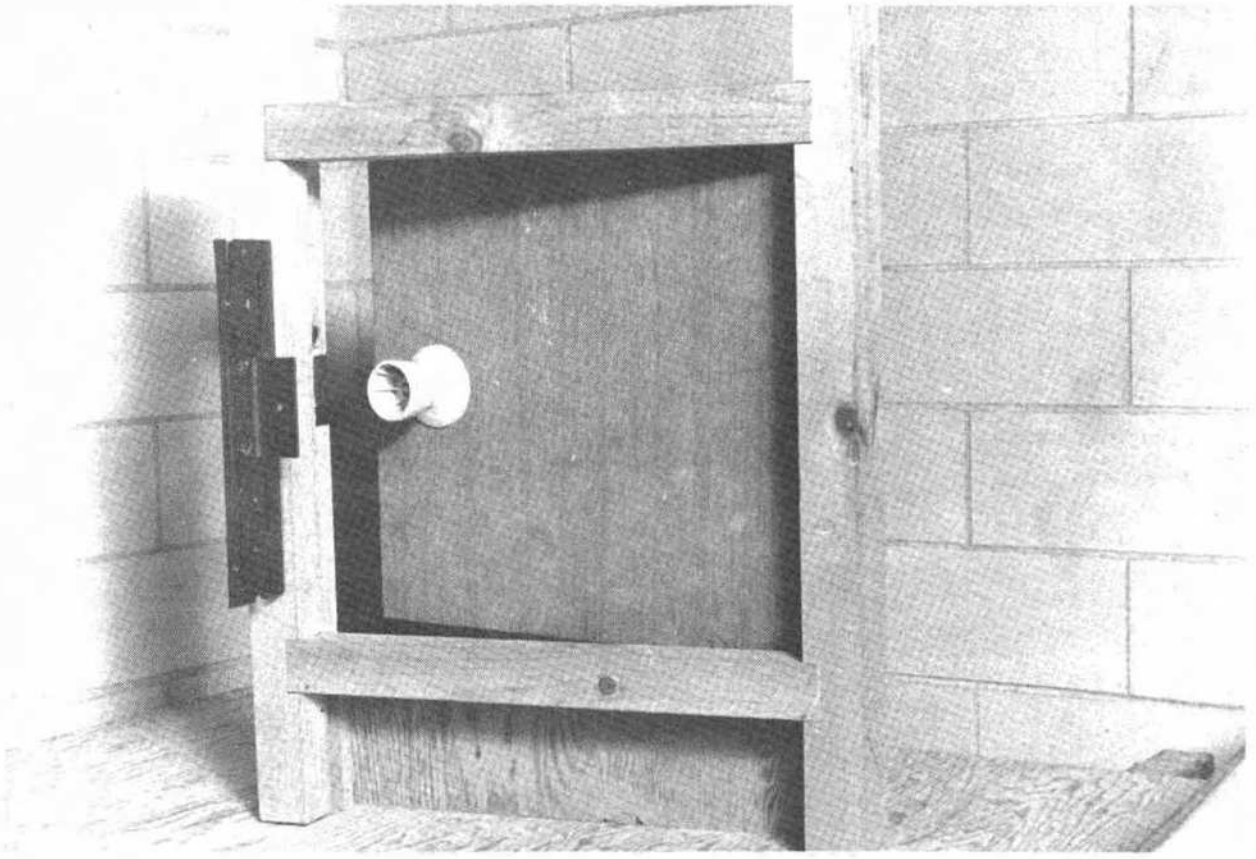

Figure 2

Test Frame

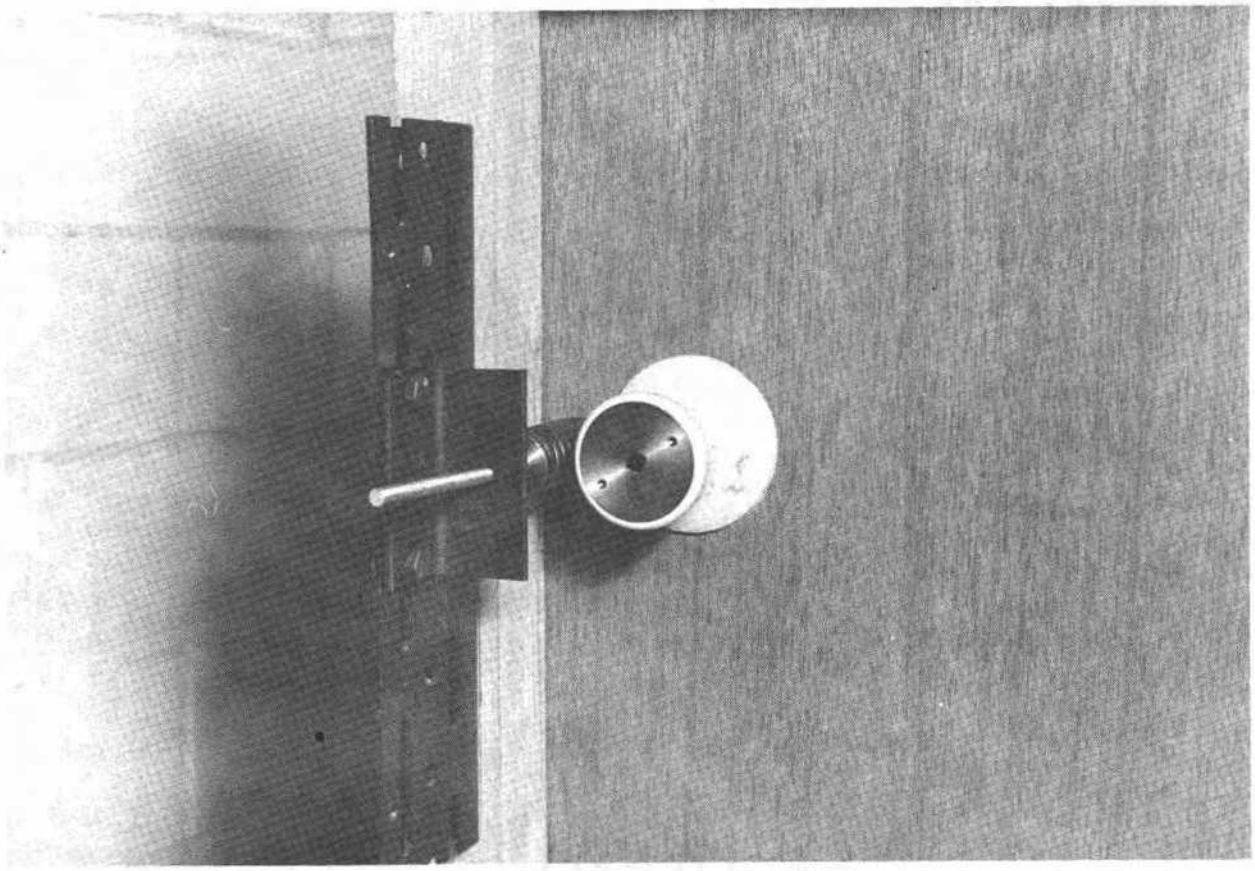

Figure 3

Compression Spring and Torque Wrench Adaptor

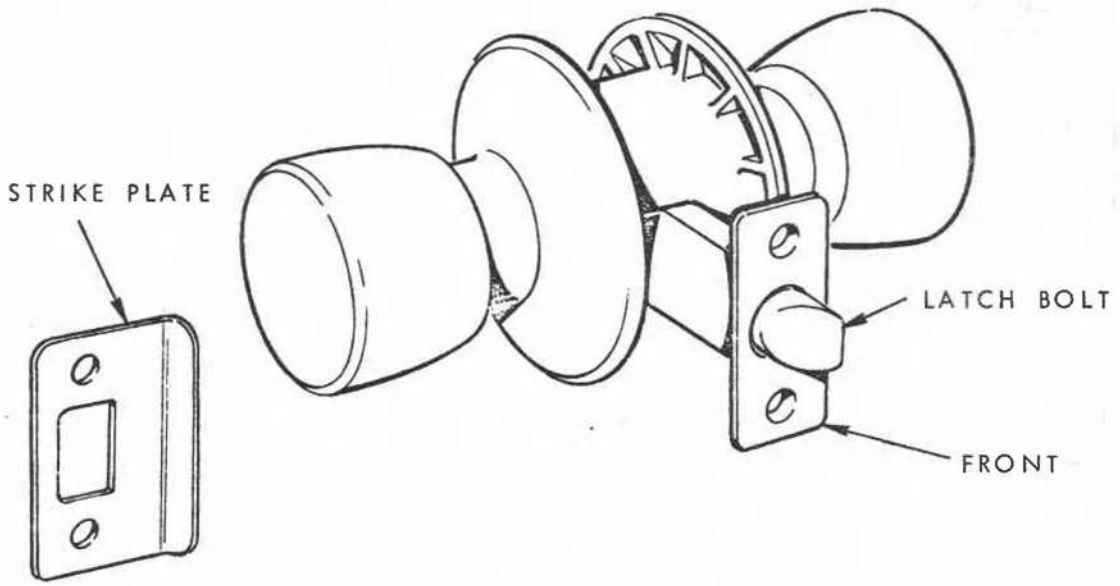

FIGURE 4A TYPE 1 LATCHBOLT IN DOOR EDGE

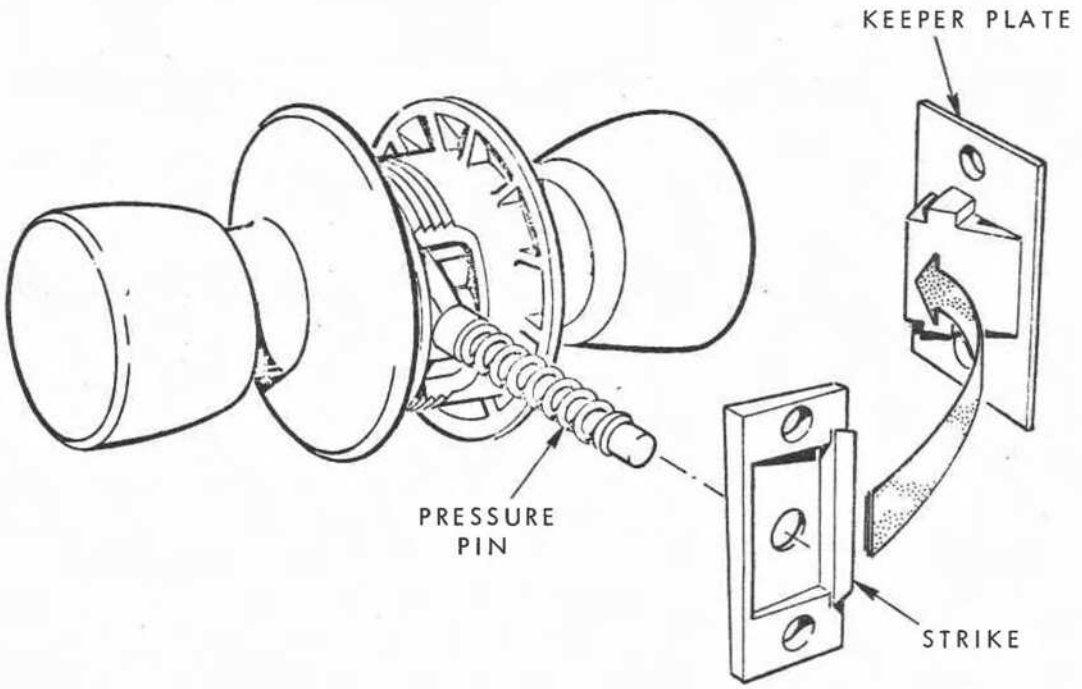

FIGURE 4B TYPE 2 LATCH MECHANISM IN DOOR JAMB

FIGURE 4 PLASTIC LOCK AND LATCH SETS

(FIGURE 1 OF SECOND DRAFT OF JAN. 1974 CGSB SPEC. 69-GP-16)

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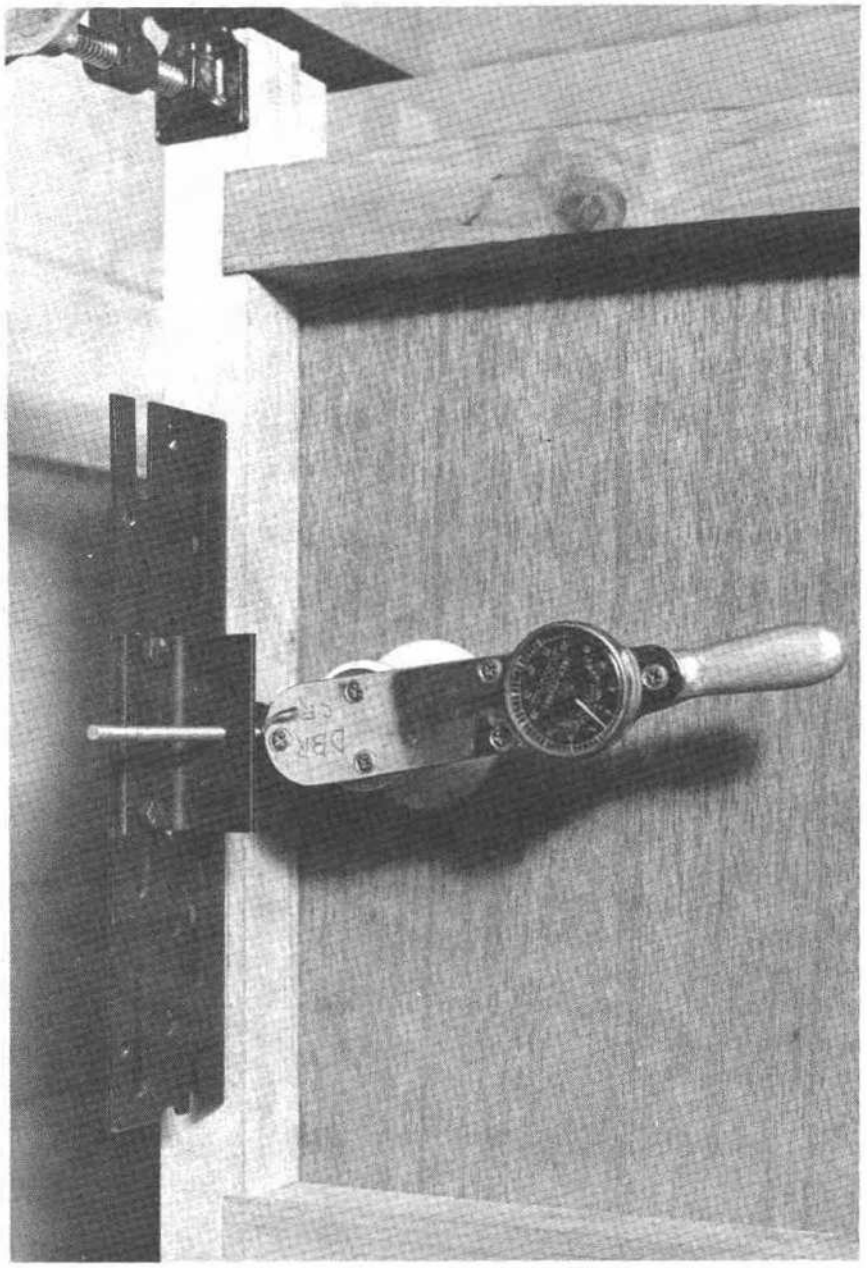

Figure 5

Torque Wrench