



Technical Brief 001

Report on Heat Generated from Recharging and Running Devices in xLocker2 and Laminate Lockers

Introduction

Planex's xLocker2 system is designed to aid collaboration, drive productivity, maximize space, and provide better flexibility than traditional locker storage. This is a personalized solution to solve the problems associated with the storage needs of individuals in communal multi-purpose work environments.

xLocker2 has been designed to provide a means of reticulating services to all the units. Each unit has a frangible port that can be soft-wired for recharging personal devices. An integrated cavity between the units provides the conduit for powering GPOs.

Personal devices that people may place inside their locker include mobile phones, tablets and laptops. These can be recharged using the GPOs. The process of recharging devices produces modest amounts of heat that can raise the temperature within the locker. Furthermore, the temperatures of laptops that run heavy workloads can generate much more heat than when recharging. Surface temperatures of powerful laptops running intensive workloads can reach about 55°C¹. This heat can even make it very uncomfortable if working with a laptop on one's lap. Placing such a laptop inside a locker may build up an appreciable amount of heat. Therefore, Planex conducted tests on their xLocker2 lockers in order to evaluate such rises in temperature. For comparison, tests were also performed on typical workplace laminate lockers.

Summary of Our Results

The results indicate that common devices can be charged inside xLocker2 lockers over many hours without raising the temperatures significantly. Typical results from testing the laptops showed about a 5°C rise inside the lockers over the ambient temperatures of an air-conditioned room. In addition, if a device is placed inside an xLocker2 locker to recharge, but has also been inadvertently left running some programs, the results show rises in temperature that would be considered to be within the normal upper operating range that the more powerful laptops may generate. We also ran tests with working laptops placed within the lockers to recharge, and attempted to replicate real-world scenarios by placing various personal items randomly inside (e.g., below, alongside or above the laptops). The tests with the xLocker2 lockers indicated that the temperatures in the immediate vicinity of the laptops could reach about 50°C, while temperatures of just below 30°C were typical of places further away from the laptops (e.g., several cm). However, the rises in temperature were larger in the laminate lockers. They reached about 40°C with only the laptop inside and having the programs running. Once more and more personal items were placed inside and restricting air flow around the laptop and its cooling system, temperature reached 66-76°C.

In conclusion, tests performed on the Planex xLocker2 System as a recharging point for laptops indicate the system's real-world suitability for such an application. The tests also indicate that the locker's internal temperatures do not rise to unacceptable levels if the laptops are charged while running many programs. However, the temperature rises in laminate lockers under the similar, extreme test conditions were significant, and therefore laminate lockers are not recommended as recharging points.

¹ New Dell precision M3800 mobile workstation versus Apple MacBook Pro with retina display. (www.principledtechnologies.com/Dell/Precision_M3800_Premiere_perf_0115.pdf)

Methods and Results

Laptop System Configurations:

System	Dell Precision M3800	Apple MacBook Air6,1	HP 530 Notebook PC	Apple MacBook Pro4,1
Processor	Intel Core i7-4712HQ	Intel Core i7	Intel(R) Core Duo CPU T2300	Intel Core 2 Duo
Processor frequency (GHz)	2.3	1.7	1.67	2.5
Memory (GB)	16 GB	8	1	2
Display	14.65"	13"	15.4" (1280 x 800)	17"

Temperature Loggers:

Easylog model EL-USB-1 temperature data loggers were used with temperature range of -35 to 80°C. Data points were collected at 5 minute intervals in tests conducted over 18-20 hours, or at 2 minute intervals for shorter tests.

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Device Setup:

1. The computer displays were set to 100% brightness.
2. The "dim the display" were set to Never.
3. The "turn off the display" was set to Never.
4. The "put computer to sleep" was set to Never.
5. The "screen saver" was disabled. On the Macs the "lock screen" was disabled.
6. A repeated series of programs were kept open during some tests, as described.
7. The setup, placement of laptops and USB loggers within locker were recorded with photographs (e.g., figures 3, 5, 6, 7 below).

Planex xLocker2 System as tested:



Figure 1: The lockers used were in a series of office furniture displays within Planex's Hallam showroom.

The black arrow points to the lockers tested. The yellow arrow points to the cabinet used as the control for external temperature measurements. An adjoining locker was used as a control for measuring normal temperatures inside the locker without any device placed inside.

The door styles tested were the Plain (no perforations), FreeFold (small random perforations), and Linea (having perforations and the acoustic panel on the inside of the door). The acoustic panel, AKUpanel, is a 6mm thick cloth-like material made from polyethylene terephthalate, is designed to dampen office sound and can insulate heat.

Locker dimensions: 4-door; 2m high; 40cm wide.
Internal dimensions: 37W x 47H x 50D.

The Laminate Locker as tested:



Locker A was tested with the laptop inside. Locker B was an adjoining locker and was used as a control for measuring normal internal temperatures. The red arrow points to the temperature logger used measure external temperatures.

Locker internal dimensions in cm: 26 W x 42 H x 46 D.

A series of tests were performed by increasing the functions that the devices were performing. For example, by only re-charging, or by running programs which increased their heat generation, or by including personal items inside the locker that acted as insulators to reduce the rate of heat dissipation from inside.

Table 1 summarizes typical results. Tests #1 and 2 indicate that while re-charging inside lockers with the Freefold doors, the relatively small MacBook Air raised the temperature by only several degrees. This was similar to the amount raised by the more powerful Dell (see also Figs 2 and 3). In lockers with the Linea doors the Dell produced more heat inside the locker when it was operating with programs running (Tests # 3 and 4).

Normally a laptop would be re-charged in modes such the Off or Stand-by or Sleep settings when placed inside a confined space such as a locker with personal items inside (e.g., clothes, books, shoes etc), and in close proximity to the device. If a laptop is inadvertently placed in such a locker while also running programs it would be expected to cause temperatures to rise. We therefore tested such arrangements as follows.

The locker was set up with the computer running programs, and with personal items (simulated by using clothes and thick cardboard) placed in adjoining lockers against the walls common to the test locker. Such an arrangement gave the data summarized in Table 1, Test #7, and seen in Figs 4 and 5. This indicates that in the Linea lockers temperatures reached the mid-40's. The locker with the laptop had no personal items inside but the close arrangement of items in the adjoining lockers provided a degree of insulation.

Tests # 8 and 9, with Figs 6 and 7, respectively, were performed with 2 arrangements of many personal items in the lockers.

Test 8 and Fig 6 used a MacBook Pro operating 10 programs. Personal items were placed inside the locker as shown in Figure 6. More personal items (clothes and thick cardboard) were placed in adjoining lockers against the walls common to the test locker, in order to give more insulation. Two temperature loggers were placed inside the locker as well as two control loggers to measure external or ambient temperatures. One of the 2 internal loggers was placed in contact with the warmest part of the laptop, which was on the lower surface directly below the Caps Lock key on the keypad. This logger also sat on top of the shoes and the bag of clothing, and was therefore very well insulated. The maximum temperatures were approximately 50°C.

Table 1: Summary of tests performed using several laptop computers placed in the xLocker2 (Tests #1-9) and in the laminate lockers (Test #10). Some tests were run repeatedly. Typical details are shown in figures 2 and 4, below.

Laptop System Configurations:

Test #	Door Style Tested	+/- acoustic panel +/- paper, books or clothes	Laptop computer and test setup		Max temperature achieved (average ambient Temp = 19°C)
			Type of computer	+/- charging from flat or running programs	
1	FreeFold	nil	Dell Precision M3800	Re-charging No programs	25
2	FreeFold	nil	MacBook Air	Re-charging No programs	23.5
3	Linea	+ acoustic panel	Dell Precision M3800	Re-charging No programs	23.5
4	Linea	+ acoustic panel	Dell Precision M3800	Re-charging & Programs running	32.5
5	Plain	nil	Dell Precision M3800	Re-charging & Programs running	25
6	Plain	nil	HP 530 Notebook PC	Programs running	36.5
7	Linea	+ acoustic panel & paper products to mimic books	HP 530 Notebook PC (USB logger in close proximity to computer's warm air flow from fan)	Programs running	44.5
8	Linea	+ acoustic panel & real-world locker contents (bag of clothes, shoes, book)	MacBook Pro 17" (10 programs running)	Programs running	50
9	Linea	+ acoustic panel & paper products to mimic books/items covering most of the 6 internal surfaces	HP 530 Notebook PC (USB logger in close proximity to computer's warm air flow from fan)	Programs running	50
10	Laminate locker	+ paper, clothes & products to mimic books/items used to cover most of the 6 internal surfaces	HP 530 Notebook PC (USB logger in close proximity to computer's warm air flow from fan)	Programs running	66-76

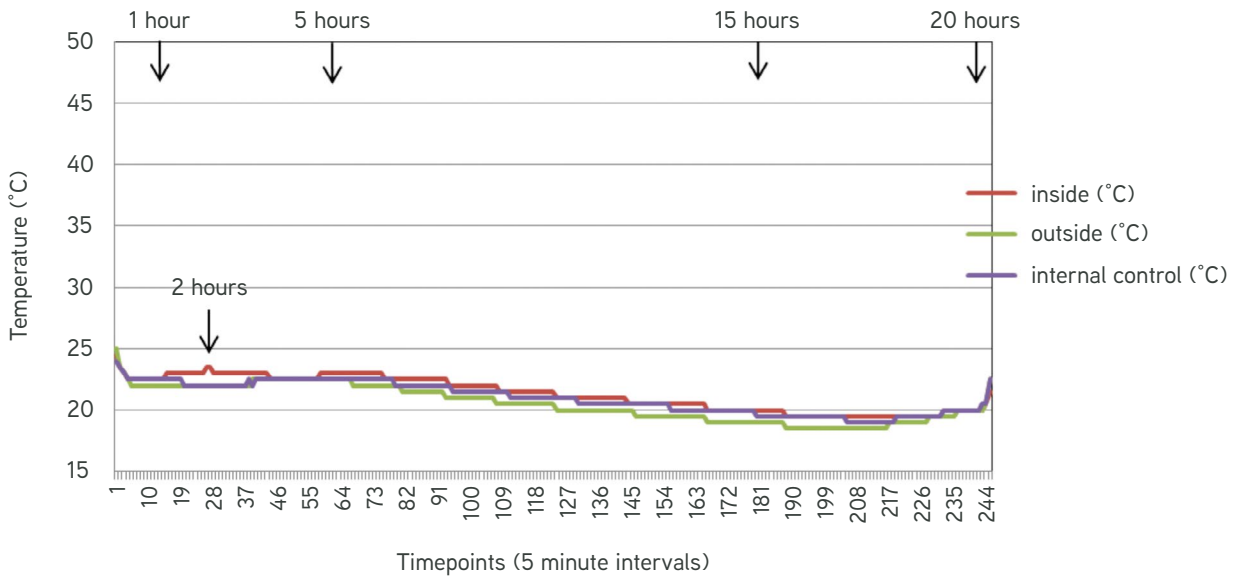


Figure 2. Temperature changes inside the xLocker2 fitted with a Linea-style door whilst having the Dell Precision M3800 charging from a flat battery. The maximum was 23.5°C at 2 hours. (Note: the dip and rise in the first and last 4-5 data points resulted from the loggers being handled.) In another test, the temperature reached a maximum of 32.5°C at 2 hours when the following programs were run while charging the battery from flat - Chrome, Origin, Adobe Acrobat, MS Access, VLC, AutoCAD, Endnote, WORD, XL and SolidWorks.



Figure 3. Dell Precision M3800 laptop setup inside locker with temperature logger in the right hand corner (results shown in Fig 1).

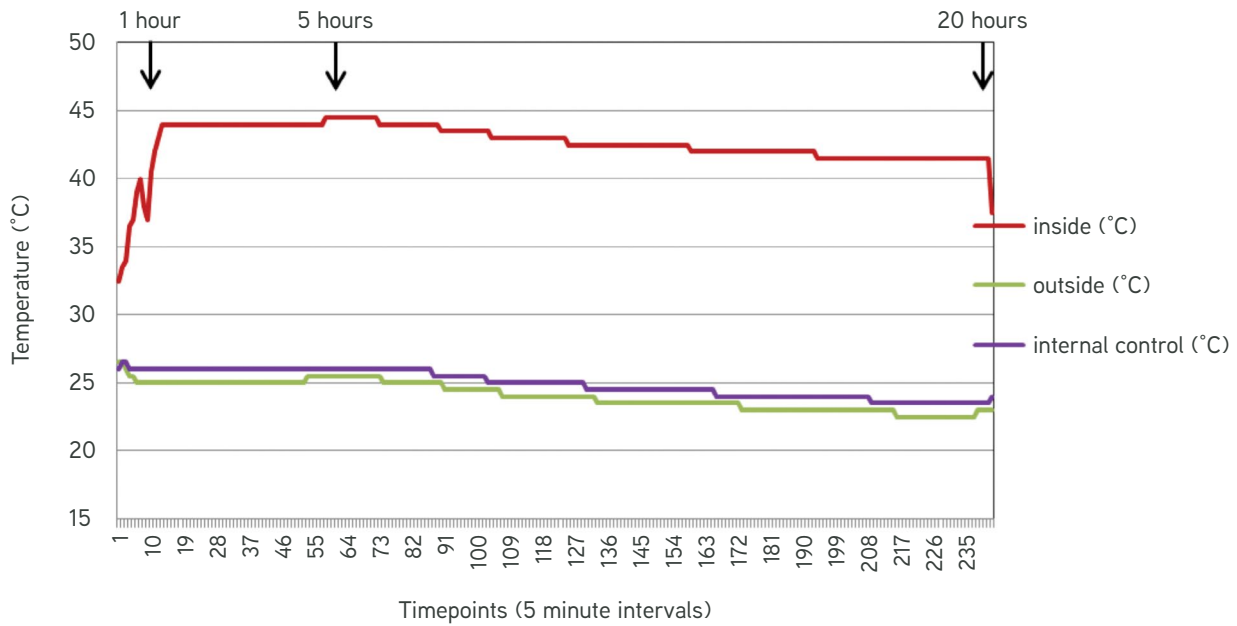


Figure 4. Temperature changes inside the xLocker2 fitted with a Linea-style door whilst having the HP 530 Notebook PC computer charging from a flat battery and the following programs running - Chrome, Origin, Adobe Acrobat, MS Access, VLC, AutoCAD, Endnote, WORD, XL and SolidWorks. (Note: due to the setup time, several minutes elapsed before the first temperature reading of 33°C was recorded; the temperature of the HP rose during this time.)



Figure 5: HP 530 Notebook PC setup inside locker with the temperature logger placed close to the laptop, near the exhaust vent of the laptop's cooling fan. Items of clothing and paper were placed inside all adjoining lockers (results shown in Fig 4).

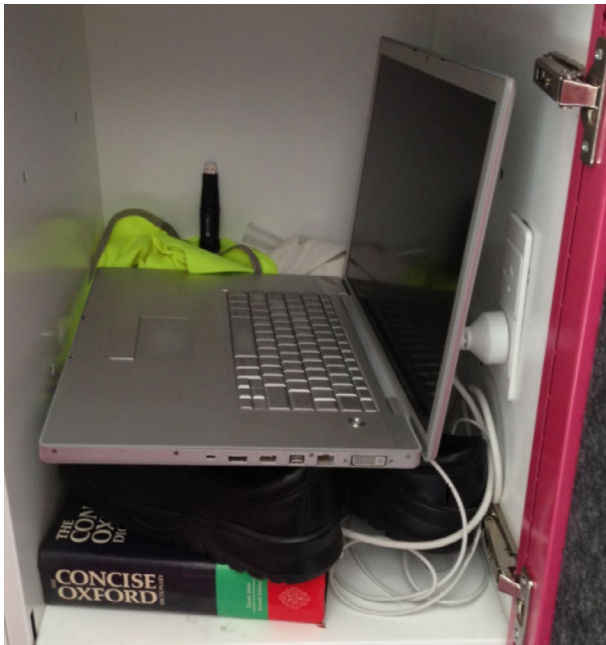


Figure 6: MacBook Pro 17" laptop running 10 programs and set up with items typically found in a personal locker. Two temperature loggers were placed inside: one as seen in the photo, as well as one placed beneath the laptop, directly in contact with the surface under the left side of the key board. The items placed inside were a bag of clothes, a pair of shoes and books.

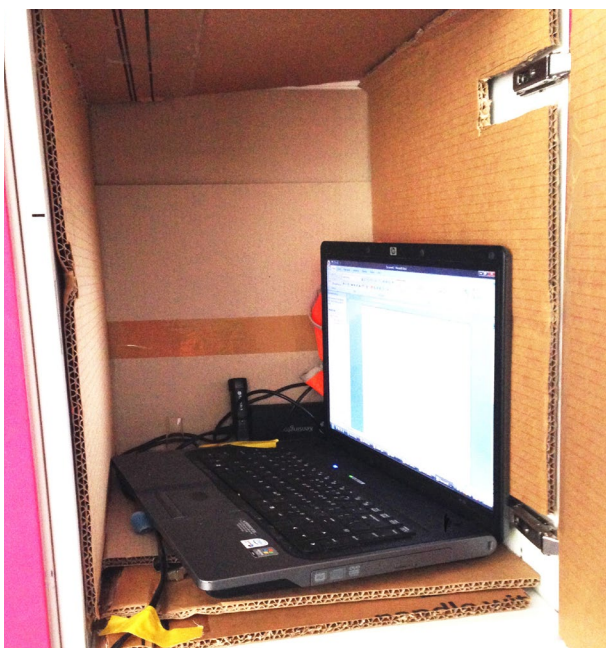


Figure 7: HP laptop running 10 programs but with an extreme degree of insulation placed on all of the 6 internal surfaces.

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Head Office / Manufacturing

191 Princes Highway, Hallam
VIC Australia 3803
PO Box 125 Hallam 3803
Tel: +61 3 8795 1100
Fax: +61 3 8795 1122
Email Head Office: info@planex.com.au

Sydney Showroom

(Mon - Fri, 9am - 5pm by appointment only)
Studio 4, Level 2
18-20 Victoria Street, Erskineville
NSW 2043
Tel: +61 2 9517 2411
Fax: +61 2 9517 2544
Email Sydney: info@planex.com.au

Adelaide Showroom

(Mon - Fri, 9am - 5pm by appointment only)
238 Grenfell Street, Adelaide
SA 5000
Tel: +61 3 8795 1100
Email Adelaide: info@planex.com.au

Perth

Tel: +61 3 8795 1100
Email Perth: info@planex.com.au

Brisbane

Tel: +61 3 8795 1100
Email Brisbane: info@planex.com.au

Tasmania

Tel: +61 3 8795 1100
Email Tasmania: info@planex.com.au

ACT

Tel: +61 3 8795 1100
Email ACT: info@planex.com.au