



Technical Brief 004

# Aesthetics versus Practical Reality and OHS Consequences

### Executive Summary

For designers creating new activity-based workplaces, aesthetics and function are critical to the success of a fit-out. However, sometimes these two criteria can be at odds and designers have to make decisions between form and function. In 2016-17 38% of all serious workers compensation claims came from body stressing. Therefore, a designer’s selection of castors for mobile cabinets can potentially impact workplace injuries.

Planex has spent considerable time investigating the aesthetics, practical realities and OH&S consequences of castor selection on mobile cabinets. The results follow common sense and therefore the choice of castors fitted to cabinets should consider both the floor choice and effort required to move the cabinet across different surfaces.

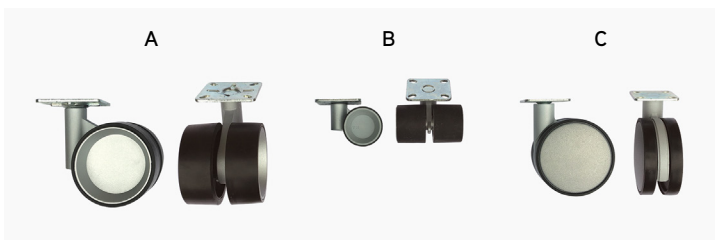
### Introduction

Planex designs and fabricates mobile cabinets for the workplace and undertook a series of tests to ascertain the amount of force required to move the cabinet across different floor surfaces. The cabinet selected was a custom made cabinet weighing 63.5kg and was loaded with 30kg of weight distributed evenly within the cabinet (Figure 1).



**Figure 1.** The cabinet used in the tests shown with arrows indicating the points for the push and pull actions.

Tests were conducted with push or pull actions at various points with a consistent standard weight that reflected a typical workplace environment. These tests were applied to three different castor sizes most typically specified by designers. The castors selected for review were 40mm dia. 80mm diameter. (narrow) and 80mm diameter (wide); see Figure 2.



**Figure 2.** The castors used in the push-pull tests.

- A: 80mm wide castors
- B: 40mm wide castors
- C: 80mm narrow castors

Referring to International Standard ISO 11228-2 Ergonomics Manual handling part 2: Pushing and Pulling as a guideline, we were able to create a baseline safety standard for our tests. Table 1 outlines the maximum acceptable forces using two hands in push/pull tasks.

**Table 1.** Maximum acceptance forces<sup>1</sup> using two hands in push or pull tasks.

	Pushing		Pulling	
	Initial Force (kg <sup>1</sup> )	Sustained Force (kg <sup>1</sup> )	Initial Force (kg <sup>1</sup> )	Sustained Force (kg <sup>1</sup> )
Female	14	5	14	6
Male	16	6	16	6

In our discussions below about forces, we use “excessive” and “reasonable” to relate these values to the values in Table 1.

Moving cabinets is an easy task when done with reasonable forethought, to avoid straining the body. On carpet, cabinets with smaller castors can be stubborn to move after the wheels have sunken into their depressions in the carpet, especially if the castors are not in line with the direction of movement and if the cabinet sits between heavy objects.

We emphasise in this report that excessive force is needed to make the initial movement of a cabinet on carpet when it has smaller wheels compared to larger ones.

### Summary of Our Results

From the various push/pull positions, the 40mm castors exceeded the standard initial force required to move the cabinet on carpet, with the exception of pushing backwards from the top corner. It also exceeded the force required from pushing the cabinet sideways in position A for men and women.

These excessive, potentially injurious forces and their push/pull actions are shaded in pink in Tables 2 and 3. An exception is the low and acceptable value of 14 kg marked in green in Table 3, for when the push was from the front of the cabinet in a backwards direction at point O. A value of greater than 18 kg arbitrarily chosen as being excessive; however, even if the arbitrary value is lowered slightly, then the 80mm castors still need less force to move the cabinet, and are therefore less likely to cause injury.






Most of these forces with the 80mm castors were acceptable (Tables 2 and 3; values shaded green). Two popular styles of 80mm castors were tested. When the cabinet was fitted with either style of the 80mm castors (Fig. 2), it generally needed lesser forces to get it moving compared to when fitted with 40mm castors.

The results may be scored out of 10 for each castor type (i.e., a maximum score of 10 coming from 6 tests in Table 2, and 4 tests in Table 3). A score of with 10/10 would be the worst case and 0/10 the best case. When presented in this way, the 40mm castors score 9/10 pink values (i.e, excessive forces), the 80mm Narrow castors score 1/10 pink value, and the 80mm Wide castors score 3/10. This helps to highlight that the 80mm castors are more acceptable in terms of such pushes and pulls.

The results from the tests on carpet are in sharp contrast to those done on linoleum, where the majority of results were much more acceptable under the test conditions, as expected (Tables 4 and 5). It is noteworthy that even on a linoleum floor the cabinet fitted with both styles of 80mm castors needed an average of less than 60% of the force that the 40mm castors needed.






<sup>1</sup> Values of force are expressed in kilogram-force, kgf, and for simplicity in this report are abbreviated as kg. Table 1 is adapted from Table A.5 in ISO 11228-2. The values of force can be more or less than those shown in the table, depending on the frequency of the task, distance travelled and handle height. They are for two-handed push or pull actions, with a handle height of 95cm for males and 89cm for females, over a distance of 8m, with a frequency of 4 pushes per minute.

**Table 2.** Carpet tests. Initial forces (kg) that are needed when **pulling** the cabinet with hands placed at several points on the cabinet. Pink shading indicates an excessive force. Values of force are usually expressed in kilogram-force, kgf, and for simplicity in this report are abbreviated as kg. The points on the cabinet used for pulling actions are shown in Figure 1.

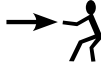






Pulling action on cabinet		Cabinet fitted with 40mm castors	Cabinet fitted with 80mm narrow castors	Cabinet fitted with 80mm wide castors	Maximum recommended forces See table 1	
					Female	Male
Pull sideways from point A		39	15	20	14	16
Pull towards front from point E		20	10	10		
Pull towards front from point G		24	15	15		
Pull towards front from point K#		35	16	19		
Pull towards front from point N#		39	16	18		
Pull towards front from point O#		21	18	10		

# the doors at points K, N and O were open to allow pulling actions to be done from the folds at the front of the cabinet's top for K and O, and from the front of the shelf at N.

**Table 3.** Carpet tests. Initial forces (kg) that are needed when **pushing** the cabinet with hands placed at several points on the cabinet. Pink shading indicates an excessive force. Values of force are usually expressed in kilogram-force, kgf, and for simplicity in this report are abbreviated as kg. The points on the cabinet used for pulling actions are shown in Figure 1.



Pushing action on cabinet		Cabinet fitted with 40mm castors	Cabinet fitted with 80mm narrow castors	Cabinet fitted with 80mm wide castors	Maximum recommended forces See table 1	
					Female	Male
Push sideways from point A		32	25	19	14	16
Push backwards at point K		22	16	16		
Push backwards at point N using knee		22	17	17		
Push backwards at point O		14	13	10		

**Table 4.** Linoleum tests. Initial forces (kg) that are needed when **pulling** the cabinet with hands placed at several points on the cabinet. Pink shading indicates an excessive force. Values of force are usually expressed in kilogram-force, kgf, and for simplicity in this report are abbreviated as kg. The points on the cabinet used for pulling actions are shown in Figure 1.

Pulling action on cabinet		Cabinet fitted with 40mm castors	Cabinet fitted with 80mm narrow castors	Cabinet fitted with 80mm wide castors	Maximum recommended forces See table 1	
					Female	Male
Pull sideways from point A		10	6	8	14	16
Pull towards front from point E		11	8	5		
Pull towards front from point G		11	5	7		
Pull towards front from point K#		12	7	7		
Pull towards front from point N#		11	6	7		
Pull towards front from point O#		7	5	5		

# the doors at points K, N and O were open to allow pulling actions to be done from the folds at the front of the cabinet's top for K and O, and from the front of the shelf at N.

**Table 5.** Linoleum tests. Initial forces (kg) that are needed when **pushing** the cabinet with hands placed at several points on the cabinet. Pink shading indicates an excessive force. Values of force are usually expressed in kilogram-force, kgf, and for simplicity in this report are abbreviated as kg. The points on the cabinet used for pulling actions are shown in Figure 1.

Pushing action on cabinet		Cabinet fitted with 40mm castors	Cabinet fitted with 80mm narrow castors	Cabinet fitted with 80mm wide castors	Maximum recommended forces See table 1	
					Female	Male
Push sideways from point A		20	6	7	14	16
Push backwards at point N using knee		11	7	7		
Push backwards at point N		10	7	7		
Push backwards at point O		9	5	4		

## Appendix

A mobile cabinet weighing 63.5kg was used for the tests, and was loaded with 30kg of weights.

The cabinet can be fitted with 40mm diameter or 80mm diameter castors.

- Dimensions 1200mm W x 850mm H x 500mm D
- Cabinet weight as tested using 30kg of weights placed evenly on its internal shelves = 93.5kg
- Cabinet weight when empty = 63.5kg
- Carpet: level loop pile with rubber underlay
- Height above the floor of the test points on the cabinet:  
With 40mm castors: Point A and similar ones = 820mm; Point N = 435mm  
With 80mm castors: Point A and similar ones = 875mm; Point N = 490mm
- Force gauges:  
Starr digital model FGD-500 Digital Instruments;  
Force Gauge model FG-6100SD



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