WHITE PAPER:

The Facts and Data on Twin Disc Wheel Designs

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Lead: In this white paper, we will discuss the ergonomic performance and real-world application of twin disc wheels as opposed to their conventional single wheel counterparts. In doing so, we will examine data from push-pull and rotary tests which disprove performance myths as well as effects of environment, capacity, and cost.

The Purpose

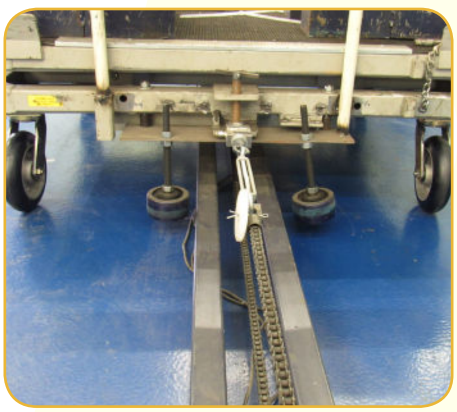
Ergonomics are essential in the discussion of material handling products. As such the study of employees' efficiency in their working environment and the products utilized for the job are critical. Every year a substantial amount of capital is lost due to downtime and injuries sustained on the job. Often these can be directly related to non-ergonomic material handling practices where the incorrect product is specified. In recent years, companies are focusing substantially more attention to the amount of effort employees exert in moving goods around facilities in an initiative to protect both employee health and the company's bottom line. At RWM, we understand the need and have specialized pieces of test equipment on site to validate caster and wheel products which help customers to select the optimum combination for each unique application. By using quantified and repeatable data in a controlled testing environment to make documented improvements we can ensure the best performing product for each and every potential use. A product has been introduced to the market which makes a claim of 35-50% reduction in start-up forces. No information in regards to the testing performed or specifics of what products may have been compared are given to support this, only a broad statement. Before analyzing the testing data contained below it is important to ask and understand how products are verified, why the testing is done and what the outcome means to your bottom line. By the conclusion of this document we will cover all aspects and provide the test data necessary to put the details in perspective.

The Process & Equipment

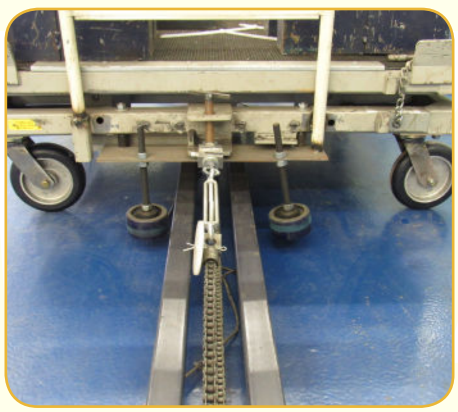
Automated Push/Pull Machine

The first piece of equipment to become familiar with is the Automated Push-Pull Test Machine. This calibrated equipment allows Engineering and Quality Assurance staff to determine the amount of force required to initiate push and/or pull of a loaded cart equipped with a particular set of four casters. Often you will see some companies utilize a handheld scale to take these measurements as opposed to a machine. While this is certainly a step in the right direction and can provide useful information if done properly, the results are highly variable and can be manipulated and inconsistent as a result of its dependency on a human operator. RWM's automated equipment on the other hand eliminates this variable. The test machine utilizes a common automotive industry sized cart that straddles a set of guide rails, which keep the cart on a straight and controlled course. The cart is pulled by a variable speed electric motor set and calibrated to exert a constant force. At the point where the chain attaches to the cart, an S-Type Load Cell allows the machine to send raw data to a digital readout gauge or to a laptop computer directly connected to the machine. This data measures the maximum amount of force in lbs required to initiate and then sustain movement of the cart configuration. This connection allows the cart to move in either direction and replicate a push or pull movement. The floor beneath the cart is poly coated to replicate floor conditions in many of today's modern factories.

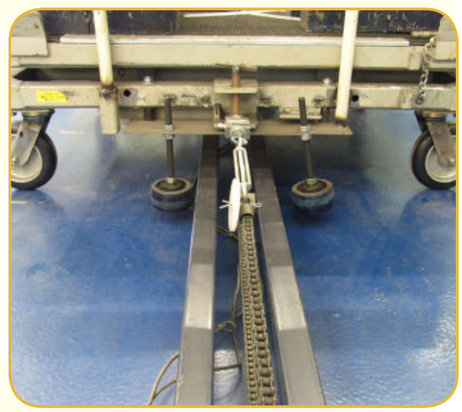
The test itself consists of several parts. For each test condition, there are seven test runs. From the seven values given, the highest and lowest values are dropped. The remaining values are averaged. These seven runs are each performed with three caster orientations: a zero degree orientation (straight line), a 90 degree orientation with the casters facing in the same direction, and a 90 degree orientation with the casters in opposing directions.



ZERO DEGREE

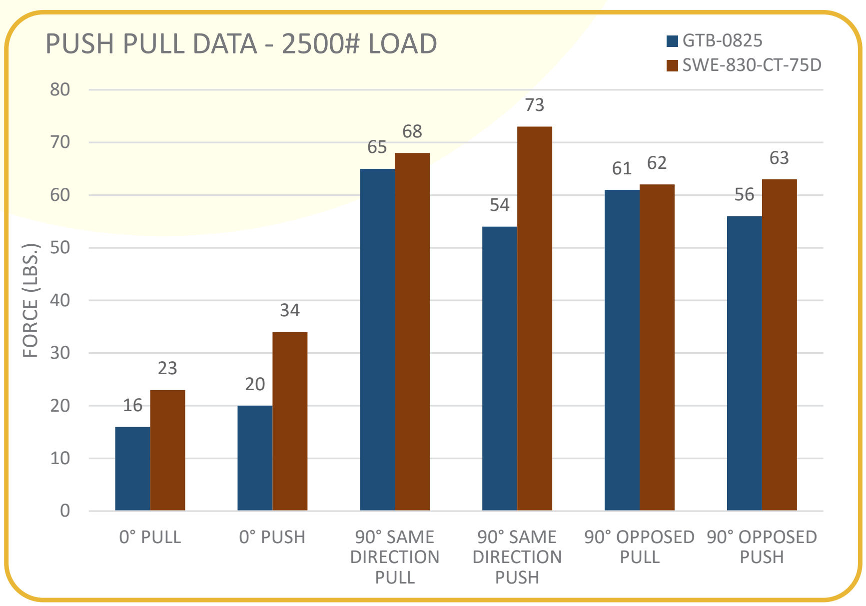


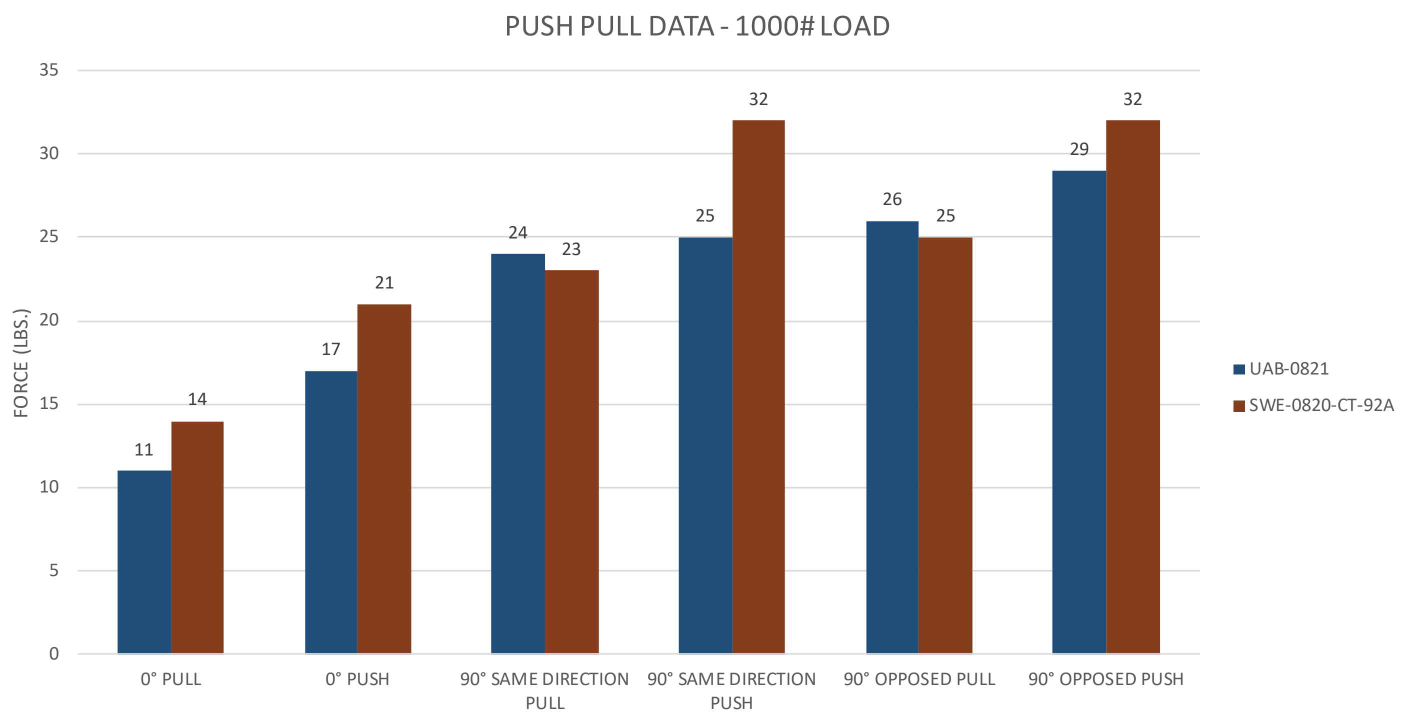
90 DEGREE SAME

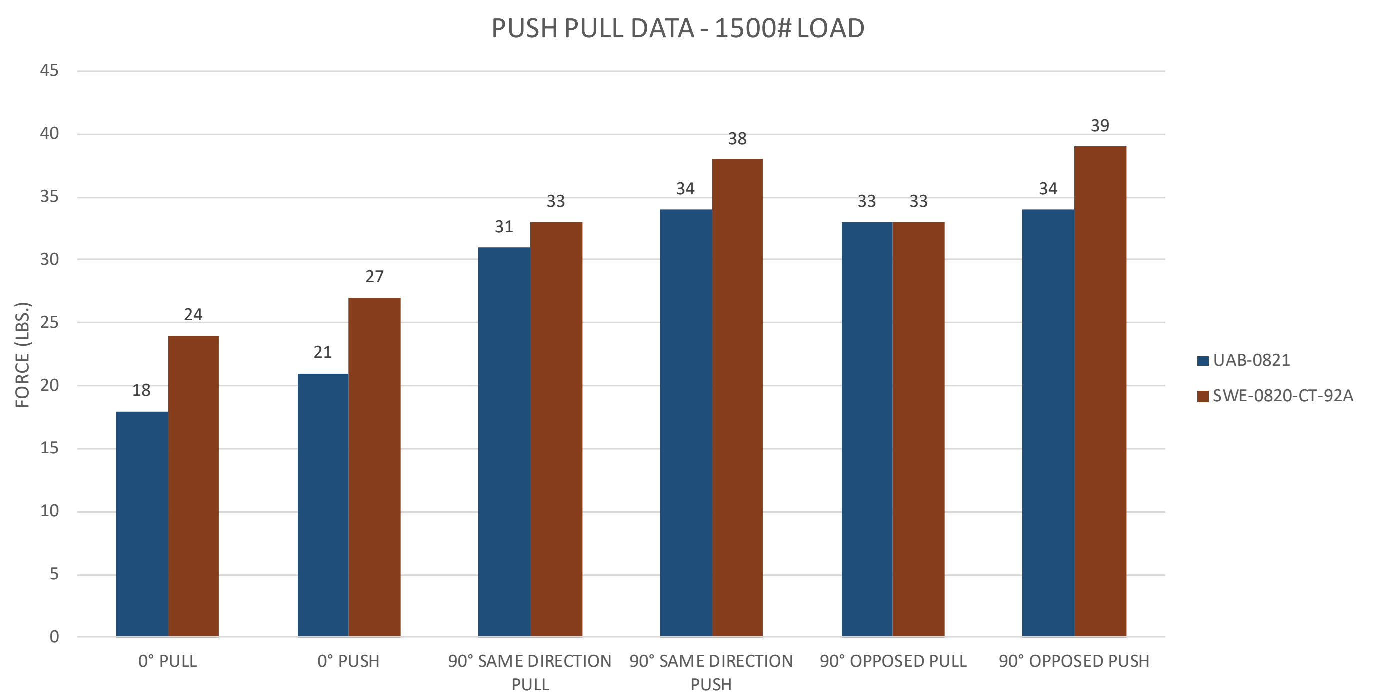


90 DEGREE OPPOSING

Loads can vary from application to application and can be easily changed for a specific test using calibrated weights within the lab. Typical manually operated loads tested are shown in Table 1 and do not commonly exceed 2,500lbs. A maximum force of 40lbs or less is the desired target for safe recurring manual operation.




PUSH PULL DATA - 1000# LOAD
FORCE (LBS.)
35
30
25
20
15
10
5
0
11
14
17
21
24
23
25
32
26
25
29
32
0° PULL
0° PUSH
90° SAME DIRECTION PULL
90° SAME DIRECTION PUSH
90° OPPOSED PULL
90° OPPOSED PUSH
UAB-0821
SWE-0820-CT-92A


PUSH PULL DATA - 1500# LOAD
FORCE (LBS.)
45
40
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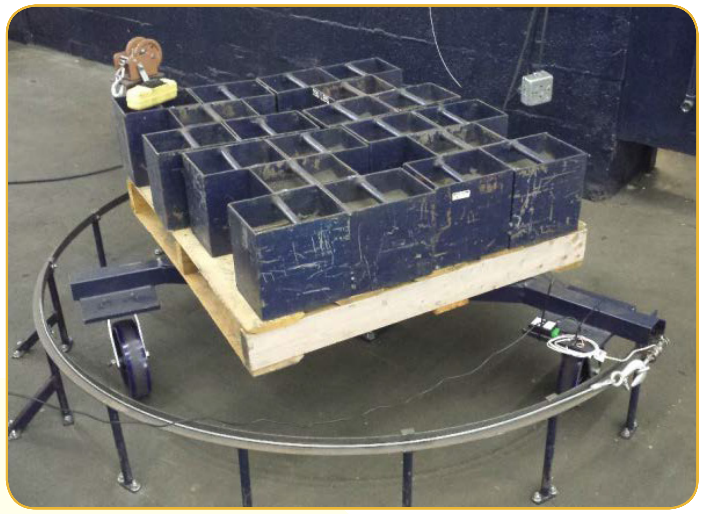
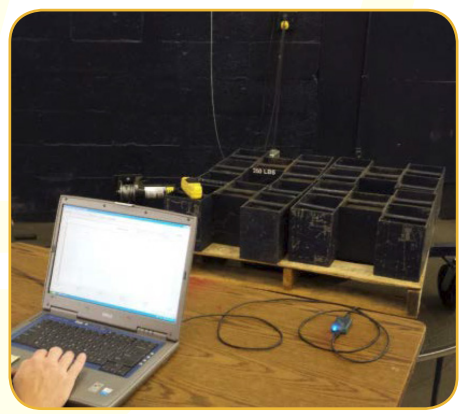
31
33
34
38
33
33
34
39
0° PULL
0° PUSH
90° SAME DIRECTION PULL
90° SAME DIRECTION PUSH
90° OPPOSED PULL
90° OPPOSED PUSH
UAB-0821
SWE-0820-CT-92A

Rotary Test Machine



A second piece of equipment was developed by RWM known as the Rotary Test Machine and allows Engineering and Quality Assurance staff to determine the amount of force required to initiate and sustain rotation of a loaded cart equipped with a particular set of three or four casters. This test was developed to measure how easy a cart or stand is to handle in tight areas and serves to cross verify data from the Push/Pull machine. This test equipment uses a cart that revolves on its center axis which is fixed to a central turntable. A cable is fixed at an outer corner of the cart and rides in a guide channel. An electric winch drive pulls the cable from one end when initiated. At the point where the cable and cart attach, a load cell allows collection of data on a computer, which provides the amount of force required to initially move and then sustain movement of the cart. This is measured in lbs of force required. The test itself consists of several runs. For each test configuration, there are five test runs. From the five values extracted, an average is taken. Moreover, each configuration can be tested at various loads dependent on the application needs.

CART SET UP 1000# - 3 WHEEL CONNECTION



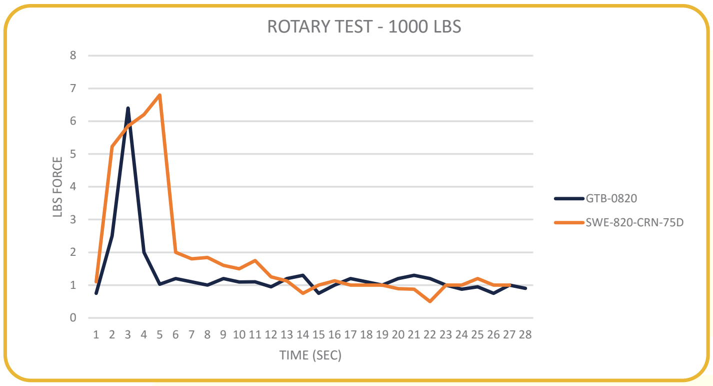
BUTTON LOAD CELL AND CABLE

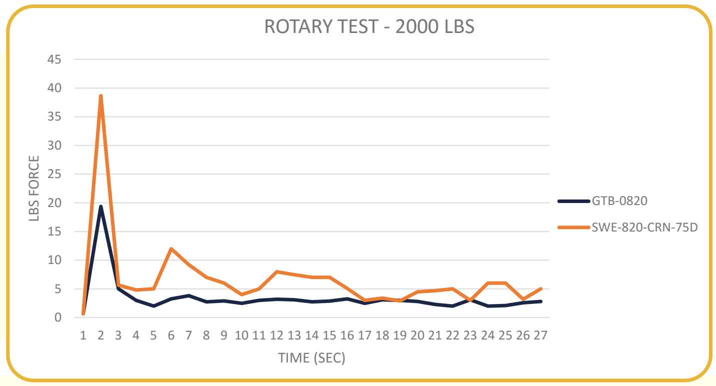
Testing & Results

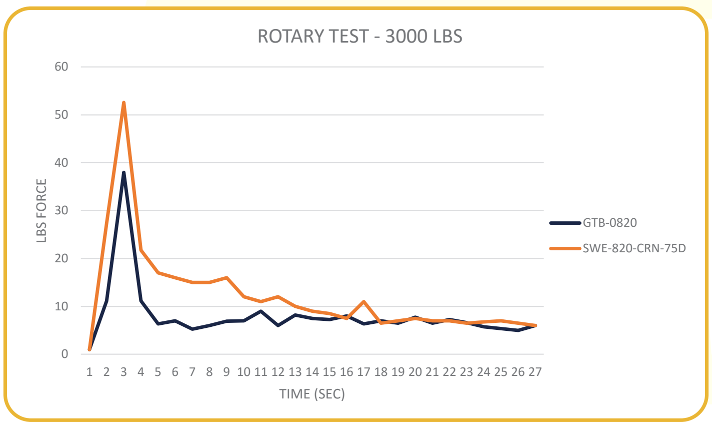
The configurations tested consist of four different types of wheels. The same caster series and rig was utilized throughout the testing to remain consistent. Testing was performed on two sets of twin disc wheels and two sets of RWM wheels of the same size and hardness/durometer. The acquired data was collected and processed into line charts showing the initial or "breakaway" force required to move the cart.

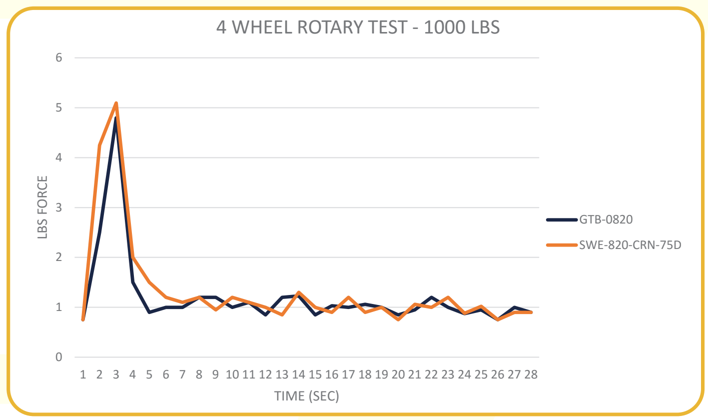
Push-pull test results on 3” wide wheels in which the twin wheels do not require a significantly lower starting force that an RWM single wheel.

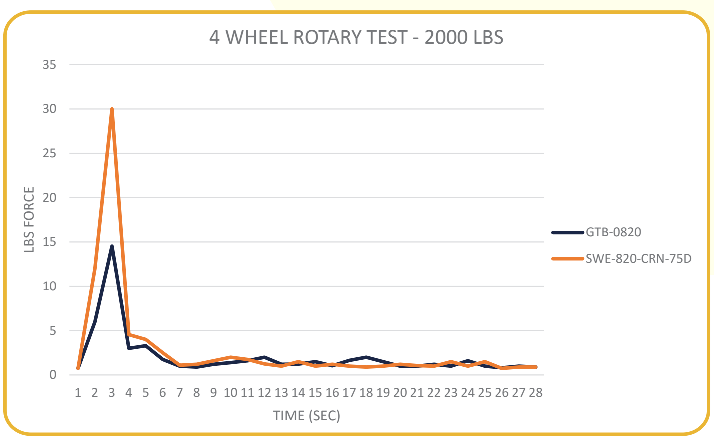
One of the misleading claims is that the twin wheel design offers a 35%-50% reduction in start-up forces during push/pull and rotary results over single wheel designs. This claim offers no supporting data. The data below shows test results run on both twin wheel and single wheel of similar durometers negating this claim.

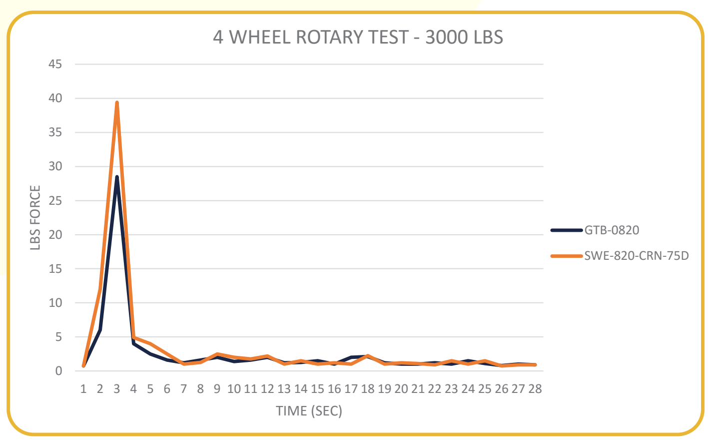












Another misnomer of the twin wheel fallacy is twin wheel designs list capacity load ratings much higher than that of its single wheel counterparts. As an example an 8 x 2 twin wheel polyurethane on aluminum 95A durometer lists a load capacity of 2400 lbs. for a crowned tread and 3000 lbs. for a flat tread wheel. Major manufacturers of caster wheels only list 8 x 2 single wheel designs as 1500 lbs. capacity based on the limitations of polyurethane.

Manufacturer	Wheel Type	Size	Load Capacity
Competitor A	Urethane on Aluminum	8 x 2	1500 lbs.
Competitor B	Urethane on Aluminum	8 x 2	1500 lbs.
Competitor C	Urethane on Aluminum	8 x 2	1500 lbs.

Another noted flaw in the twin wheel design, is the loss of floor contact due to uneven surfaces. It was observed during testing that in certain instances one wheel on the twin would stop rolling due to a depression in the floor surface. In this instance the entire load is thrust upon one half of the wheel assembly. This is never the case with single wheel designs. Therefore, the floor surface in which the application is used becomes a primary concern and source of error with twin wheel designs.

Debris handling is a concern in many applications. Commonly, most single wheel structures will either roll over, push away, or pick up small debris. With a twin wheel design, there are possible instances where large particle debris may become lodged between the two wheels. This can cause injury or damage to the wheels, which will produce material handling failures.

All claims of benefit from using a twin wheel design are unsupported by any published data or testing. With this statement, is it necessary to pay a higher cost for a wheel that does not do all that it claims?