Purchase, Operation and Maintenance of a Container Crane Spreader

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Abstract

One of the most important components in the operation of container terminals is the crane spreader. It is critical to have spreaders that adequately address the needs of the terminal and operate reliably, to avoid unnecessary down time. This article provides a general overview of issues that should be considered when purchasing a spreader. By considering procurement, maintenance and reliability, operational issues and industry trends it is possible to select a spreader that will be productive for many years. As part of this article, the results of an informal survey on spreader performance and selection are presented.

INTRODUCTION

The most abused item on a container crane is the spreader. Since the spreader is the only crane component which physically contacts the container, it is also the component most susceptible to damage from impact loading, operator miscalculations and abuse. Yet, even though it is subjected to these conditions, a spreader should continue to function properly. Failure of this component can cause operations to cease or, in the worst case, an accident with injuries and property losses. If the spreaders have the proper operational components and are given the proper maintenance, they will be very efficient, giving the terminal operator a high pick volume. In this article we will analyse the issues involved in purchasing, maintaining and operating fixed and telescopic container crane spreaders in the marine terminal industry (Figure 1). We will also present the current market and terminal operator trends based on information obtained from an informal survey of the industry, which resulted in responses from 13 of the world's major marine container ports and terminals.

Figure 1
Twin-Lift spreader offloading a Maersk ship

Figure 2
RAM shock absorbent spreader

PURCHASING

Marine terminal container crane spreaders are used in the operation of quay, rubber tyred, mobile harbour, stacking and rail mounted yard cranes. What types of spreader designs are on the market? What type of spreaders are most commonly used by other container terminal operators? What should be considered when procuring a spreader?

Design choices

Some of the well-known spreader manufacturers are Paceco, Bromma, Stinis and Ram (Figure 2). These manufacturers have designed spreaders for many types of operations. This has led to a variety of designs such as light-weight or heavy-duty crane spreaders, twin-lift spreaders and fixed spreaders ranging in load-carrying size from 10 to 45 feet and telescopic spreaders that are used for 20, 30, 40, 45, 48 and 53 foot containers. The more esoteric types include combination self-centring telescopic spreaders, rotating telescopic spreaders, grapple arm spreaders and adjustable twin-lift spreaders (Long-Twin Spreader). Given the fact that there are such a variety of choices available, which type of spreader should be chosen? While the answer depends on the specific needs of the terminal, our survey shows that a 20/40/45 spreader is an excellent choice, while a twin-lift spreader may also be a good candidate.

The most popular type of spreader in the container terminals that participated in our survey was the 20/40/45 spreader. Of the different types of spreaders listed above, the total number of spreaders for each category were: 707 20/40/45 spreaders, 31 twin-lift spreaders and only 64 of all other types combined. The facilities using these spreaders operated a total of 217 Quay Container Cranes, 33 Rail Mounted Gantries, 60 Bridge Cranes, and 467 Yard Cranes (RTGs). It is not difficult to see why the 20/40/45 spreaders are so popular. With a typical lift capability of 35 to 50 tons in a single lift and an adjustable frame, the 20/40/45 spreader is able to pick different sizes of containers while having a good lifting capacity. While not as popular as the 20/40/45 spreaders, there is an industry-wide trend towards purchasing twin-lift spreaders for quay container operations. With the ability to pick two containers at a time, port terminal clients often request the use of twin-lift spreaders to decrease the time to load and unload. In cases where they can be used, twin-lift spreaders can be an efficient tool for port terminal operations.

When purchasing more than one spreader or adding new spreaders to the current inventory, should the new spreaders be selected such that all of them have the same lifting capacity? Consider the typical situation: quay crane spreaders are usually manufactured with a lifting capacity of 50 tons, while 65 tons is typical for twin-lift operations. On the other hand, the spreaders for the yard cranes are usually manufactured for lighter picks than the quay cranes. Typical yard crane spreaders have a lighter frame and a lift capacity around 40 tons. Why not have the same lift capacity as quay crane spreaders? If you can have the same type of spreaders, not only do you preserve the ability to move the heavy loads throughout the yard, but you also obtain the benefit of having less maintenance training and an inventory with fewer parts.

The increasing use of twenty-foot containers by shippers on deck and in forty-foot cells has driven operators to find new ways of increasing productivity by handling two twenty-foot containers at the same time. This has led to the increasing use of twin-lift spreaders and innovative designs by the spreader manufacturers (Figure 3). The purchaser now has the option of a simple twin-lift or an adjustable twin-lift spreader. The

Figure 3
Stinis Long-Twin lift Gantry Crane Spreader

simple twin-lift has the capability to only pick two twenty-foot containers in a forty-foot space. However, the adjustable twin-lift has the ability to perform this move and, in addition, can adjust the gap between the two twenty-foot containers. This adjustment enables the spreader to adjust the gap, which typically ranges from 0.0 to 1.6 metres. Additionally, the twin-lift centre twistlock housings can be adjusted vertically. This versatility enables the terminal operators to handle any size container and in any deck/cell arrangement.

Once a decision has been made to purchase a specific type of spreader, consideration should be given to the modern features available. Today, spreaders can be found with simple contact switch technology and advanced microprocessor technology. What do these technologies offer? Consider the simple contact switch technology. This technology uses switches to detect when a condition has occurred. Examples are twistlock position switches, spreader-landed switches, flipper position switches and station position switches. A contact switch will tell you whether a certain condition has occurred. It is then up to the operator to take whatever actions are necessary based on the information provided by the switch.

Now consider the more advanced systems. Given the current advances in microcomputers and microprocessors, it was only a matter of time before this technology would start to appear in spreaders, giving rise to 'smart spreaders'. Should we stay with the conventional, simple, switch control mechanisms such as limit switches, or should we move to the new performance standard – the smart spreader?

The new performance standard in spreaders is the fully automated and controlled spreader. These smart spreaders have sensors and switches that allow the spreader to collect information on various parameters and conditions. This information can then be transmitted to the crane using fibre optic or wire communication, and is used to interface directly with the crane's control system that is monitored on the control computer screens. Simultaneously, the information is analysed and used for sophisticated operations such as automated positioning, self-levelling, condition monitoring and diagnostics operations. For example, a twin-lift spreader detection system (Figure 4) detects the presence of two twenty-foot containers in a forty-foot ship cell by detecting the gap between the two containers.

However, the more complex a system becomes, the more likely it is to fail. For example, one of the failures that maintenance personnel have noticed is that certain new technology sensors and switches are not capable of withstanding the constant impact vibrations produced by container operations. This leads to inadequate performance and wasted time trying to override the system. Sometimes, the simple control system operating via limit switches, will be more reliable than the fully automated and controlled system. Also, failures in the more complex system may be more difficult to trace and require trained personnel to diagnose and repair. On the other hand, the fully automated system can provide more feedback and warning when an operational problem is detected. The decision on which system to use is difficult, since the smart systems are relatively new. Only time will tell if these systems are more reliable than the simpler ones. For now, if a smart system seems to be a viable option, the decision should be made with advice from the maintenance organisation, keeping in mind the available level of expertise.

Two other features to consider are anti-sway systems and shock-absorbing systems. While anti-sway capabilities are usually a feature of the crane, some systems have components of the anti-sway system on the spreader headblocks and frame. Unfortunately, this means that other spreaders within the terminal are not compatible with these systems. This problem was solved at the Port of Miami by using a specially designed interface frame (Figure 6) to accommodate an RTG's headblock and anti-sway components. The interface frame spreader headblock was designed to have the same dimensions as the headblocks on the quay cranes, thus allowing the use of the quay crane spreaders while still maintaining the anti-sway capabilities of the RTG.

The last option to consider is a shock absorbing system (Figure 7). As the description implies, shock absorbing systems reduce the effects of impacts on the spreader during routine operation. Shock loading and vibration can contribute to a number of problems such as loosening of equipment, which is typical of any mechanical system subject to vibrations. Shock loading also produces higher levels of stress in spreader components. The end result of using a shock absorbing system is less maintenance problems.

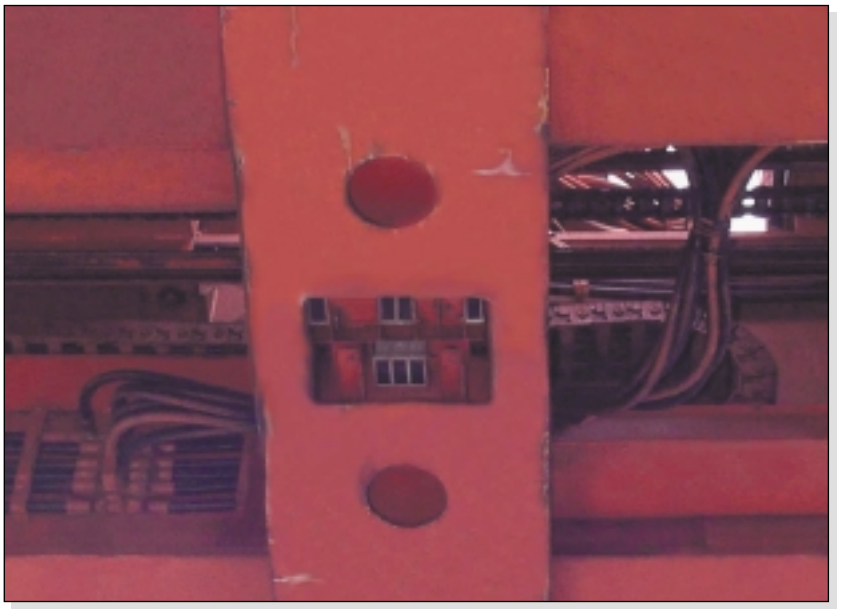

Figure 4 (top)
Twin-20 detection system mounted on the underside of a Bromma twin-lift spreader at the Port of Miami

Figure 5 (above)
Hydraulically retractable twistlock housing mounted at the mid-pint of RAM 2610 Twin Lift spreader

Procurement

Procurement procedures can be very different, depending on the type of organisation that regulates the terminal/port. For example, in some regions, private companies have

Figure 6
Specially designed Interface Frame on new Mi-Jack RTG for the Port of Miami Container Terminal

Figure 7
New shock absorbent system on RAM spreaders

a better chance of obtaining the proper equipment than government regulated organisations. This is primarily due to the different selection procedures. One specific selection criterion that is commonly used is to buy from the lowest bidder. This type of selection may result in substandard equipment and services. A well known saying best summarises the outcome of these selection procedures: 'pay-me-now or pay-me-later'.

Regardless of whether you are an operating or a non-operating port/terminal, be sure that before preparing the contract specifications you have solicited comments and recommendations from the maintenance and operating organisations that will be working with the spreaders. Due to their daily contact with the equipment, they have the most knowledge of what works properly for the type of operation employed at the terminal. Take their recommendations seriously and incorporate them into the specifications.

Once your organisation has finalised the specifications you may have several possible procurement procedures available. The most common procedures are to advertise for proposals or to purchase directly from a manufacturer. Advertising usually provides competitiveness between manufacturers, resulting in a better sales package. However, your organisation may already feel comfortable with a given manufacturer whom you feel will give you a fair package price for the spreader(s). Whatever option you choose (assuming you have options), take your time selecting and procuring the spreader(s) you require. One additional step that can save you from ending up with the wrong spreader is to make sure you review and approve the shop drawings prior to fabrication.

A practice that can be very advantageous to an owner is to use equipment from at least two different manufacturers. This procedure will ensure competitive proposals as well as very efficient warranties and operational maintenance services from the manufacturers. Unfortunately, this means that you will need to maintain additional parts in your inventory.

MAINTENANCE

Just like any other equipment, if a spreader is not abused and the terminal has an effective preventive maintenance (PM) programme, the spreader will operate effectively for many years. Make sure you have an inspection/maintenance programme in place. You should have qualified technicians and engineers on staff. If you do not have them, hire them. They will be the key to a successful operation. Keep your maintenance staff properly trained through a progressive training programme.

Your maintenance schedule should include daily inspection and operation checks prior to crane operation, as well as weekly and monthly inspections and operational checks. Keep accurate logs and have the inspector/technician sign-off. Schedule the spreaders for PM as planned. Do not deviate from the maintenance schedule or this will soon become common practice and will only worsen with time. If you happen to have a smart spreader, make sure to monitor your control and monitoring system, since this will be your first line of defence when problems arise.

Inspections should be performed to verify the frame's structural integrity and alignment. Search for cracks by performing annual non-destructive testing (NDT) on key structural spreader components such as the frame and twist-locks. Cracks in a structure act as stress risers and can result in structural failure, especially if the cracks are in a highly loaded section of the structure. If you find any cracks, contact the manufacturer or obtain the assessment of a qualified engineer.

Assuming a component of the spreader needs to be replaced, it would be simpler and much more efficient to have a local parts suppliers. When you purchase a spreader be aware that if parts and components are not locally available, you may have to wait up to several months to receive a single part or component for the spreader. Can you afford that kind of down time? If possible, specify that parts should be locally available.

Since, sooner or later, spreader components will fail, resulting in down time, what are the primary causes of failure and what components are most likely to fail? The industry survey indicates that the primary cause of spreader down time is equipment abuse. The average down time for operational abuse ranges from 19 minutes to one hour, if the terminal does not have a backup spreader available. Not surprisingly, the spreader flippers are the components that receive the most abuse. Another operational cause of spreader down time is the normal shock/impact loading that takes place during routine opera-

tion. The vibration from this loading usually loosens equipment and components. This is one area where shock absorbent systems provide a definite advantage.

In terms of actual component failures, the most problematic components are the limit switches. The next problematic area is the hydraulic system, which is subject to leaking and cylinder failure. The third problem area is water intrusion into electrical and control components. On a long-term basis, water intrusion into electrical components can cause corrosion damage resulting in short circuiting or sticking components. The short-term effects of water intrusion are short circuits which generate intermittent misleading signals.

OPERATIONS

The ideal operational programme should have regularly scheduled training classes for the crane operators. Since abuse during operation is the number one cause of spreader downtime, operator training is extremely important. This should include training on performance and proper spreader operation. Through these training programmes, the operators are made aware of the consequences that spreader abuse has on their production.

Another basic but useful operational practice is to keep a backup spreader on site, close to the cranes or at the maintenance storage yard in case unexpected problems arise. If a problem arises and the backup spreader is not close to the operational crane, down time can be minimised by switching spreaders with an adjacent, non-operating crane.

From an operational standpoint, should you have a twin-lift spreader mounted on a crane as opposed to a single-lift spreader? While your terminal will have to spend more money procuring the twin-lift, in the long run it is more cost effective since you will not have the labour and down time associated with switching the spreaders when a twin-lift is requested for the operation (Figure 8).

CONCLUSIONS

When purchasing a spreader, you need to consider the needs of the terminal in light of the spreader designs available. Experience from other ports shows that a 20/40/45 spreader is a good choice, although a twin-lift is a viable alternative. It is usually best to have all the spreaders of the same type and lifting capacity, whether they are to be used in quay or yard operations. That makes them interchangeable and decreases maintenance training costs and spare parts inventory. Consideration must also be made as to what features are desirable and, in particular, whether or not a smart spreader would be a good alternative. Remember to consider your maintenance capabilities and the level of expertise of your maintenance personnel before deciding. Make sure you have a good maintenance programme and keep to it. Train your operators and make sure they can work the cranes properly with minimal spreader damage. Make your best-informed decision, purchase your spreader and go to work.

ABOUT THE AUTHOR

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Figure 8
Bromma Twin-Lift spreader on Port of Miami Quay Gantry Crane No. 9

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IF YOU HAVE ANY ENQUIRIES REGARDING THE CONTENT OF THIS ARTICLE, PLEASE CONTACT:

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