Scientific Research Publishing

Open Journal of Safety Science and Technology, 2022, 12, 65-71
https://www.scirp.org/journal/ojsst
ISSN Online: 2162-6006
ISSN Print: 2162-5999

Replacement of Folding Lid Stay Hinges on Fish Stocking Tanks with Pneumatic Struts Improves Worker Safety

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How to cite this paper: Krebs, E., Huysman, N., Voorhees, J.M. and Barnes, M.E. (2022) Replacement of Folding Lid Stay Hinges on Fish Stocking Tanks with Pneumatic Struts Improves Worker Safety. *Open Journal of Safety Science and Technology*, **12**, 65-71.
https://doi.org/10.4236/ojsst.2022.123006

Received: March 11, 2022
Accepted: September 3, 2022
Published: September 6, 2022

Abstract

Fish transport tank lids are frequently supported by folding lid stay hinges. While these hinges are safer than no supports, stay hinge failure has resulted in several injuries to aquaculture workers. This article describes the replacement of folding lid stay hinges with pneumatic struts. These commonly-available and relatively-inexpensive struts greatly reduce the risk of occupational injury. In South Dakota, USA, head, back, arm, and serious hand injuries have all occurred because of folding lid stay hinge failure. Since replacement of the stay hinges with pneumatic struts, no further injuries have occurred.

Keywords

Folding Lid Stay Hinge, Pneumatic Struts, Worker Safety

1. Introduction

Aquaculture workers experience some of the highest rates of injury and illness among all occupations [1] [2]. Musculoskeletal injuries are particularly prevalent [3]. Repeatedly lifting nets of fish occurs frequently during fish culture operations and when loading fish onto transport tanks [4] [5] [6]. In addition to the risk of overuse injuries [5], manually loading fish into tanks on trucks or trailers exposes workers to pinching or crushing injuries [6].

Myers and Cole [5], Ogunsanya *et al.* [7], Myers *et al.* [8], and Myers and Durborow [9] documented smashed or severed fingers due to premature lid closures on fish transportation tanks. Myers *et al.* [8] noted the problem with unsecured tank lids and briefly described three possible solutions: wedges, locking hinges, and pneumatic struts. The photographs of locking hinges shown by

Myers and Durborow [9] are technically called folding lid stay hinges.

Folding lid stay hinges are used by many manufacturers on stocking tank lids. They are easily made with simple materials at little cost. The most common design consists of an attachment point on the lid, a length of metal angle bolted at the point of lid attachment, a flat bar of metal bolted a short distance from the end of the angled piece, and an attachment point on the tank to which the opposite end of the flat bar is bolted (**Figure 1**). When a lid is opened, this hinge is designed to pivot slightly past 180-degrees to lock the lid into the open position. (**Figure 2**). To unlock, upward pressure is applied to the lid and the stay hinge is tugged at the center, permitting it to pivot closed (**Figure 3**).

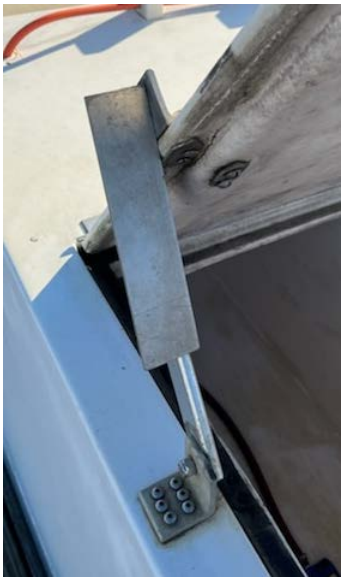

Figure 1. Photograph of a typical folding lid stay hinge on a fish transport tank.

Figure 2. Photograph of folding lid stay hinge locked in an open position.

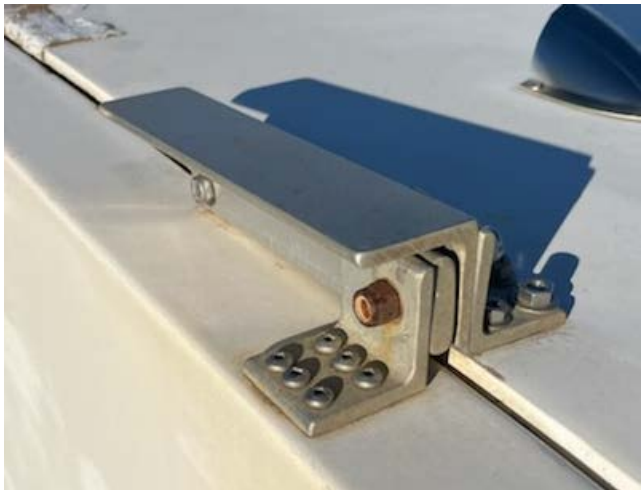

Figure 3. Photograph of a closed folding lid stay hinge.

2. Issues of Folding Lid Stay Hinges

Folding lid stay hinges can be unreliable if the lid is not raised entirely to the distance required for them to engage. This can be problematic if the truck with the tank is parked on a slope typical for fish transfer and for employees of shorter stature (Figure 4). A folding lid stay hinge can appear locked when a lid is opened just short of engaging it fully at the center joint. While the lid will remain open in this condition, a small amount of wind or movement of the transport vehicle can cause the lid to close accidentally. The nuts and bolts used at the rotating points can also loosen and come apart over time, leading to hinge failure and unexpected rapid lid closure. This can even occur if nylon-infused locking type nuts are used, as the authors of this paper have observed. These bolts cannot be completely tightened to allow rotational movement, which only contributes to their eventual loosening. It can go unnoticed that a stay hinge has come apart when a lid is opened, and this has resulted in occupational injuries.

While admittedly better than no locking mechanisms, folding lid stay hinges are still problematic. In the US state of South Dakota, two serious hand and finger injuries have occurred within the last ten years because of folding lid stay hinge failures. Three other instances of premature folding lid stay hinge closure have caused head, back, and arm injuries. Since replacement of the folding stay hinges with pneumatic struts on fish transport tanks, no subsequent injuries have occurred. This manuscript describes the modification done to retrofit pneumatic struts on fish transport tanks originally outfitted with folding lid stay hinges.

3. Pneumatic Struts

The addition of pneumatic struts to stocking tanks is not difficult, and in most cases requires few materials or tools. Pneumatic struts consist of a shaft inside of a dual walled sealed cylinder that can extend exerting force and retract, having attachment points at both ends (Figure 5). Struts are commonly available with

Figure 4. An example of a folding lid stay hinge unable to be fully raised to a locked open position.

Figure 5. An example of a pneumatic strut used on a fish transport tank lid.

socket type ends that mate with metal studs consisting of a rounded ball and threaded end (**Figure 6**). They are inexpensive and readily available at most auto parts stores. Because pneumatic struts come in several different sizes (overall lengths and stroke lengths) and force ratings, they are easily configurable to various lid sizes and weights.

3.1. Pneumatic Struts Used

In South Dakota, folding lid stay hinges were replaced with one pneumatic strut per lid for each fish transport tank compartment (**Figure 7**). The struts and studs (part numbers 8195590 and 735-1896, NAPA Auto Parts, Atlanta, Georgia USA) had the following characteristics: 385 Newtons maximum force (lift), 260 mm compressed length, 431 mm extended length, 175 mm stroke length, 8 mm inside shaft, 18 mm outside cylinder, and ball end type.

Figure 6. Pneumatic strut socket-type end with a corresponding ball on a threaded stud.

Figure 7. Pneumatic strut in a closed position on a fish transport tank.

3.2. Pneumatic Strut Attachment

Pneumatic struts were mounted with aluminum angle (50 mm × 50 mm × 76 mm). Six holes were drilled in the sides of the brackets to attach them to the top of the lids and tank. A hole for the ball studs was drilled in the opposite side. Placement of the brackets was 133 mm from the center of the tank lid hinge to the center of the lid bracket and 401 mm to the center of the tank bracket. Six stainless steel, self-drilling screws and gasket forming sealant were used to affix the brackets (**Figure 8**, **Figure 9**). Because the fish transportation tank and lids were double walled—with a 3.17 mm thick outer aluminum metal layer and insulated, a large bracket with six screws was used to provide secure anchoring. The sealant was used to prevent water intrusion into the insulation layer of the tank and provided additional adhesion. While it is possible to mount the brackets using fewer bolts and nuts passing completely through the tank and lid, this would increase the risk of water infiltration and prevent proper lid closure. In addition, while this configuration replaced the folding lid stay hinge with only

Figure 8. Attachment of a pneumatic strut to a fish transport tank using aluminum angle.

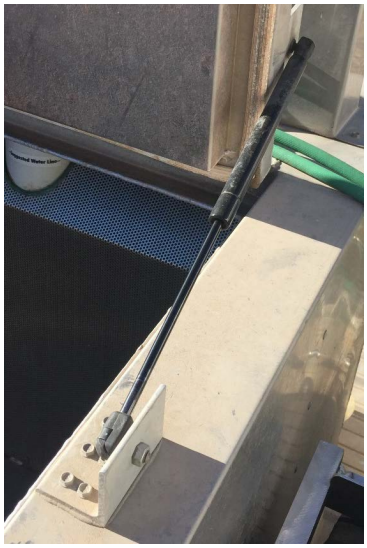

Figure 9. Attachment of a pneumatic strut to a fish transport tank with the lid in a fully-open position.

one pneumatic strut, additional struts could be used, or a strut could be added while still retaining the folding lid stay hinge.

3.3. Pneumatic Strut Considerations

The struts will eventually weaken and fail. To ensure maximum safety and relatively minor expense, a two-year replacement schedule is recommended. Strut failure is easily identifiable. In normal operation, lifting a tank lid a few inches will cause the lift, via its own force, to raise the lid completely. If a partially-raised lid does not continue to open under its own power, the lift is beginning to malfunction and should be replaced.

4. Conclusion

While folding lid stay hinges are better than no lid locking mechanism at all, be-

cause of the injuries caused by their failure, they should be replaced with pneumatic struts. Using the modifications described in this manuscript to switch from folding lid stay hinges to pneumatic struts has eliminated worker injuries resulting from falling tank lids. Folding lid stay hinges should be replaced with pneumatic struts to maximize aquaculture and fisheries occupational safety and health.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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