

## K-28 hand pump- how to improve?

**Original Topic URL:** [http://www.mylargescale.com/forum/topic.asp?TOPIC\\_ID=46132](http://www.mylargescale.com/forum/topic.asp?TOPIC_ID=46132)

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**Topic author:** David Rose

**Subject:** K-28 hand pump- how to improve?

**Posted on:** 23 Apr 2007 08:54:40

While running my K-28 this weekend I started to wonder how to improve the hand pump set-up. Pumping in water at 0-30 PSI is easy, but when the boiler gets up to 60 PSI things get ugly. It's extremely hard to pump, the pump looks like it's going to rip off the tender floor, hoses pop off from the pressure..... I think this is for two reasons:

- The ram on the hand pump is huge. Switching to a pump with a smaller ram (trying to ram in less water with each rotation) would help.
- The check valve/good-all/clack-valve (whatever it is) takes considerable pressure to open. If I remember correctly someone stated this takes like 10-20 PSI just to open. Then add this to the boiler pressure.

Does anyone have any ideas/suggestions for a happy medium ram size on the hand pump?

Is there a more efficient check valve available for the backhead?

Any suggestions on hose that is flexible, can get hot, and can handle around 100 PSI?

## Replies:

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**Reply author:** highpressure

**Replied on:** 23 Apr 2007 09:42:16

The biggest problem is the thing they call a check valve. When pumping against pressure it takes 35 to 40 PSI to get it to open. If the loco has been sitting unused for a while it may not open at all as it will be stuck shut like it has ben glued. If you change to a vertical "BALL" type valve, pumping will be much easier. I made the one shown below from a flea-market casting & it has a fitting to assist in connecting & disconnecting the hose so my "OLD" hands can do it.



Also you can put a ball lift limiter on the Accucraft pump and it will increase the quantity of each stroke. Drill & tap 2-56, the top outlet cover. Install a 1/2" long 2-56 brass or stainless screw with a brass or stainless nut on it with a bit of sealer on it. By hand, screw the screw down until it contacts the ball. Run the nut down to the pump lid & back it off until a .030" feeler gauge fits between the nut & the pump lid. Then holding the screw tighten the nut to the pump lid. This way the ball has a limited lift and can't chatter between strokes. This will help on any of the Accucraft pumps.



**Reply author:** Charles

**Replied on:** 23 Apr 2007 09:42:52

Dave

Why 100 PSI on the engine....(as if I did not know)

Yes, getting rid of the Accucraft check valves, handpump, etc will help; we did so- now having clack valves with balls instead of the Accucraft "shuttlecocks" spindles.

Several places have check valves and/or pumps

<http://www.djbengineering.co.uk/index2.html>

<http://www.sssmodels.com/>

and alternative

<http://www.home.earthlink.net/%7Ebfindus/id1.html>

[http://www.steamfittings.co.uk/asp/components\\_subcats.asp?CatID=3](http://www.steamfittings.co.uk/asp/components_subcats.asp?CatID=3)

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**Reply author:** HKPorter04

**Replied on:** 23 Apr 2007 11:19:25

Dave,

I had the same problems with my new SP-0-6-0. To fix the problem, I made a new hand pump with a 5/16" diameter ram, and replaced the check valve. Contact me off-line, I may be able to help you.

Joe

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**Reply author:** Ray C.

**Replied on:** 23 Apr 2007 12:35:35

Larry,

When making your own checks, how do you machine the seat that the ball drops on to? Does the seat need to be lapped?

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**Reply author:** GWRdriver

**Replied on:** 23 Apr 2007 14:26:21

Larry,

40psi!?!? Holy cow, what kind of contraption are they using??

I have run some numbers. Let's say we have a conventional ball-type check valve with a 5mm ball diameter and the ball is not stuck and needs no abnormal force to raise it off its seat and we ignore friction and other mechanical losses. The area of the ball seat must be somewhat less than the full cross-sectional diameter of the ball, so let's use 75%. A 5mm ball then has a seat area of .023in<sup>2</sup> and at a boiler pressure of 60psi the seat only "sees" a pressure of .023 x 60psi or 1.38lb. That's how much pressure it will take to raise a 5mm ball (X .75) off its seat against 60psi.

As for the pump, for the sake of discussion, let's say the ram is 10mm diameter which gives an area of

0.122in<sup>2</sup>. The instant the ball is lifted off its seat the pump ram will "see" 60psi boiler pressure. The area of a 10mm ram is .122in<sup>2</sup> thus it will see .122in<sup>2</sup> x 60psi or 7.32lbs.

If a pump has a handle arranged to make a 2 or 3 or even 4:1 mechanical advantage, as most are, then the force required at the pump handle to overcome boiler pressure will be between 2 and 4lbs and I eat plates of oatmeal cookies that weigh more than that! So where are all these 10, 20, 30, and 40psi numbers coming from?

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**Reply author:** jfrank

**Replied on:** 23 Apr 2007 15:35:03

David, I know you are seriously looking for assistance with the hand pump, but I just quit using it. I use a goodall valve instead and one of Norm Saley's pump bottles. I think the goodall valve was from Sulphur Springs. I agree the hand pump on the K28 is next to useless and will eventually split open the bottom of the tender. An even better option might be one of the electric pumps with led and sensor.

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**Reply author:** Semper Vaporo

**Replied on:** 23 Apr 2007 15:38:54

First and foremost... you are eating way too many oatmeal cookies! A bag of cookies is usually less than a pound, say 12 to 14 oz. If you are eating 3 to 5 bags of cookies per plate, that is just way too many.

Now, chocolate chip cookies, I could understand, but... oatmeal?

Anyway, I agree with your assumptions and calculations. And numbers don't lie, or so I am told. But in this case, something is amiss.

I am sure that some of it is my own inexperience with actually measuring the amount of pull on the pump handle and I am sure that I would be surprised at the actual number on a scale.

I have a hard time pumping water into a boiler when it is at 45psig. To keep from blowing the hose off the nipple on the engine on my mikes, I have the hose shoved over a 3/4in length of copper tube and a spring from a ballpoint pen wound around the whole thing, as a clamp to hold the hose to the pipe. If the hose stretches, the spring winds tighter over the connection.

(The spring also extends beyond the length of pipe as a compression wrap on the hose. I have at times had a leaky check valve on the boiler and the hose would heat up from the reverse flow of steam, expand like a balloon and burst.)

But the question is still there as to why it is so hard to pump water into the boiler when the pressure is only 30 to 60psig? Is our experiential knowledge of how much one pound is, such that the numbers are right and our hands are that weak (even with the mechanical advantage of the pump lever) or the tender tank base is that flexible so as to look like it will tear out?

A smaller pump ram is one answer, but I understand the Aster Mike tender pump is of the "small" variety and it is still hard to work. Also the smaller pump just requires lots more cycles to pump much water. I have a friend that has the 3-cylinder Shay and his pump only requires 2 or 3 cycles to replenish the boiler, whereas I have to pump 2 dozen times on the Mikes.

I sometimes have to open the blower and manually lift a safety to rapidly reduce the pressure so I can pump in water, but that is a bit counterproductive... it is also kind'a dumb if I am needing to pump water in

because I am low on water!!!

Again, I agree with your numbers... maybe we just don't know how many cookies are in a pound? ;-)

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**Reply author:** GWRdriver

**Replied on:** 23 Apr 2007 16:20:10

quote:

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I agree with your numbers... maybe we just don't know how many cookies are in a pound?

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Charles,

In my scenario I ignored internal friction and mechanical loss, but in practice those are very much present. I'd imagine that some of the difference comes from the drag created by boiler pressure acting against the walls of the pump through the O-ring. We also assume that all the bits fit well and rubbing surfaces are smooth, and they may not be.

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**Reply author:** Semper Vaporo

**Replied on:** 23 Apr 2007 16:30:13

That and trying to force water from a 3/8in. diameter cylinder through a 1/16in. diameter pipe certainly adds friction, too!

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**Reply author:** highpressure

**Replied on:** 23 Apr 2007 19:33:51

Harry'

Hello, how's everything on your side of the mountain ?

Accucraft uses a horizontally mounted check assembly (I refuse to call it a valve). Inside is a thing that looks like a rivet with an "O" ring of .130"OD on it facing the seat for a seal. Facing the boiler (PRESSURE SIDE) is what looks like a phosphor bronze spring .012" wire dia wound .120 " od and .400" long. Sitting dry for a while some times they stick & have to be removed and pushed open with a 1/16" pin punch. Very poor design. I have had very good luck with the vertical valves. Here's one I made for an Accucraft 3 cyl Shay that the pump would not open the assembly. It works very nicely now.



Larry Herget LS-2173

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**Reply author:** highpressure

**Replied on:** 23 Apr 2007 19:45:38

Ray C'

On my vertical valves for pumps & check valves. After rough finishing the casting & doing the basic passage drilling I ream the center hole thru the casting from the part farthest from the seat area. This gives the reamer time to settle in before cutting the ball hole. The seat is then finished with a 15 degree "D" bit, giving a negative rake to the seat. A ball is dropped in and tapped with a brass rod & light hammer (LIGHTLY) while sitting on the seat to seat it. That ball is discarded (TRASH) and a new ball put in it's place. Works every time, ask Harry.

see ya

Larry

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**Reply author:** GWRdriver

**Replied on:** 23 Apr 2007 20:44:44

Larry,

The current general wisdom now calls for a straight seat, no angle.

Also, something very important . . . As we all know (and Larry also knows) a drill bit does not produce a round hole and in order to have a good seal (or any seal :-o) the seat has to be truly round. The most common way to produce a round hole, aside from boring, is to ream it. A reamed hole will be far easier to seal than a drilled hole. When clearances allow it I now burnish my valve seats by putting a few thicknesses of common newsprint under a ball (soldered to a rod) which is rotated in the drill press for a moment. This technique was suggested to me by Mike Chaney and produces a good seat, but most people still rely on rapping a sacrificial ball to form the seat.

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**Reply author:** GWRdriver  
**Replied on:** 23 Apr 2007 20:45:49

Larry,  
The current general wisdom now calls for a straight seat, no angle, . . . and things are busy here.

Also, something important . . . As we all know (and Larry also knows) a drill bit does not produce a round hole and in order to have a good seal (or any seal :-o) the seat has to be truly round. The most common way to produce a round hole, aside from boring, is to ream it, or a reamer substitute such as a D-bit. A reamed hole will be far easier to make seal than a drilled hole. When clearances allow it I now burnish my valve seats by putting a few thicknesses of common newsprint under a ball (soldered to a rod) which is rotated in the drill press for a moment. This technique was suggested to me by Mike Chaney and produces a good seat, but most people still rely on rapping a sacrificial ball to form the seat.

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**Reply author:** Semper Vaporo  
**Replied on:** 23 Apr 2007 21:38:59

Does the newspaper just grind up to become like a polishing compound? (I figure if I did that the newspaper would sieze to the seat area and just polish the ball real well and leave me with lots of "pita" work picking the paper out of the body of the valve.)

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**Reply author:** GWRdriver  
**Replied on:** 23 Apr 2007 21:49:42

Charles,  
Apparently the newsprint is just abrasive enough to burnish the seat as it gets cut between the ball and the edge of the seat. The seat edge does cut a wad, and you have to pick the "wad" out of the hole. That's about it.

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**Reply author:** David Rose  
**Replied on:** 24 Apr 2007 06:14:52

quote:

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*Originally posted by jfrank*

David, I know you are seriously looking for assistance with the hand pump, but I just quit using it. I use a goodall valve instead and one of Norm Saley's pump bottles. I think the goodall valve was from Sulphur Springs. I agree the hand pump on the K28 is next to useless and will eventually split open the bottom of the tender. An even better option might be one of the electric pumps with led and sensor.

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John,

While I agree the hand pump is not 100% necessary, and I even wondered why it was there back when I got the engine (the K-27 does fine without one). But now I've gotten to the point where I kind of like the convenience/novelty of having it there. I'll see what I can do to make it work more efficiently, while knowing it's not critical to the engines operation.

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**Reply author:** Chris Scott  
**Replied on:** 24 Apr 2007 17:21:41

David:

Some time ago Dave Hottmann modified an Accucraft water pump to change the pivot or link points to get better/easier leverage with each stroke. This is the thread: #5 Shay Bunker Mod:  
[http://www.mylargescale.com/forum/topic.asp?ARCHIVE=true&TOPIC\\_ID=22776](http://www.mylargescale.com/forum/topic.asp?ARCHIVE=true&TOPIC_ID=22776) But it is from May 04 so most of the pictures are not there but the description is. If it sounds helpful, maybe you could write Dave for the pictures.

Dave also made a new version of the traditional hand pump he detailed in the thread: Three Truck Hand Pump: [http://www.mylargescale.com/forum/topic.asp?ARCHIVE=true&TOPIC\\_ID=21405](http://www.mylargescale.com/forum/topic.asp?ARCHIVE=true&TOPIC_ID=21405)

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**Reply author:** bfordfl  
**Replied on:** 25 Apr 2007 17:25:19

David:

I've had varying success with vertical clack valves. Sometimes they work great, sometimes intermittently, and other times the ball just would not seal. Instead of trying to re-seat the ball, I designed a Goodall type, Clack-less one way valve to replace the faulty ball type check valve for use in one of my locomotives using the WLDS system and electric pump. The machining of the valve is fully described in a construction article to appear in an upcoming SITG. issue.

I have also heard from some Accucraft Mogul owners that the check valve on the back head contains a strong spring behind the ball which requires excessive force to open the valve to allow water to be injected into the boiler. Although my electric pump will pump against >90 psi, the spring can be changed to reduced the pressure and using the new Vertical Probe, a complete WLDS system can be installed without the need to drill any holes in the boiler.

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**Reply author:** Ray C.  
**Replied on:** 25 Apr 2007 21:24:42

quote:

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*Originally posted by highpressure*

Ray C'

On my vertical valves for pumps & check valves. After rough finishing the casting & doing the basic passage drilling I ream the center hole thru the casting from the part farthest from the seat area. This gives the reamer time to settle in before cutting the ball hole. The seat is then finished with a 15 degree "D" bit, giving a negative rake to the seat. A ball is dropped in and tapped with a brass rod & light hammer (LIGHTLY) while sitting on the seat to seat it. That ball is discarded (TRASH) and a new ball put in it's place. Works every time, ask Harry.

see ya  
Larry

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Thanks, Larry (and Harry). The "D" bit you speak of, is this a commercially available cutting bit? And, in the case of the 'straight' style seat, is that produced using a regular straight 'fluted' style reamer? Does the ball simply seat on the shoulder where the bore steps down in size? Thanks again in advance.  
Ray Cadd



**Reply author:** David Rose  
**Replied on:** 26 Apr 2007 05:49:06

quote:

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*Originally posted by bfordfl*

David:  
.... Instead of trying to re-seat the ball, I designed a Goodall type, Clack-less one way valve to replace the faulty ball type check valve for use in one of my locomotives using the WLDS system and electric pump. The machining of the valve is fully described in a construction article to appear in an upcoming SITG. issue...

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Thanks Bill. I had an offline discussion with one of my train buddies yesterday about using a good-all type valve instead of the stock Accucraft check valve. I think it's a good idea. I have not removed the stock check valve yet. Is the hole on the beackhead for the check valve a M5x.5 thread?

Step 1 is to upgrade the check valve. Then see how hard the pumping still is.

Step 2 is to upgrade the hosing. (any suggestions? Metal braided available?)

Step 3 replace the pump to one with a smaller ram (if still too hard).

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**Reply author:** Charles  
**Replied on:** 26 Apr 2007 08:20:25

Dave

I think you will have to do step 1 & 3 (either replace or redesign) then determine if it still difficult to pump. Replacing the line to prevent "blow out" is a wise choice. Interesting, most of your modifications on your loco would seem to fit in with the WLDS solution...

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**Reply author:** David Rose  
**Replied on:** 26 Apr 2007 08:31:42

Charles,

Yes, I happen to have one of the WLDS systems. May consider using it. Do you have a recommendation on tubing? What type do you use on your engines?

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**Reply author:** GWRdriver  
**Replied on:** 26 Apr 2007 09:15:39

quote:

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The "D" bit you speak of, is this a commercially available cutting bit?

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Hi Ray,

They are available ready-made in England but I don't recall seeing any in the US, because they aren't widely used here, but a supplier like MSC, Travers, or J&L might have them. The thing about D-bits though is that they are easy to make at home. All that's needed is the right size carbon steel drill rod, a file or two (or bench grinder), a small torch, and what ever quenching medium the steel calls for. Tool suppliers sell HSS rounds which make good D-bits but the available diameters are very limited.

quote:

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in the case of the 'straight' style seat, is that produced using a regular straight 'fluted' style reamer? Does the ball simply seat on the shoulder where the bore steps down in size?

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Yes and yes, and also FYI the optimum ball to seat diameter ratio is 5:4 or thereabouts.

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**Reply author:** bonzo1953

**Replied on:** 26 Apr 2007 10:31:46

Here is a handy link for check valve details.

<http://www.ggls.org/CheckValves/index.html>

Keep 'em Steamin'

John

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**Reply author:** GWRdriver

**Replied on:** 26 Apr 2007 10:59:28

John,

VERY handy . . . need oy say more!

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**Reply author:** bfordfl

**Replied on:** 26 Apr 2007 16:26:02

David:

I'm not sure of the thread size on the Mogul. I made my Clack-less Check valve for my Roundhouse Fowler and used 1/4-40 threads. Obviously the design can be changed to meet your requirements.

As for tubing from the pump to the boiler, I use thick wall silicone tubing with good success. The barb to tube connection needs to be wire wrapped or secured by some other means as the pressure on these joints can be high. Braided high pressure tubing is available, however I haven't found it necessary in my installations.

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