LifeJacket Technical Training

Jim Murphy Adams Elevator
Version 1.1 Revised 1 August 2003

Contents

Life Safety System

The *LifeJacket* for Hydraulic Elevators is a life safety system specially designed for hydraulic elevators to prevent the elevator from moving in the downward direction in the event of a catastrophic failure. Safeties have long been required on traction (steel roped) elevators to stop the elevator if the elevator over speeds in the downward direction.

Hydraulic elevators were built without safeties because it was believed that a hydraulic elevator could only descend as fast as oil flowed through the hydraulic valve.

Assuming 4-1/2" Plunger							
Hole Size	Gallons Per Minute				Hole Size	Feet Per Minute		
(d, in)	150	300	600		(d, in)	150	300	600
0.0	0	0	0		0.0	0	0	0
0.1	3	4	6		0.1	4	5	8
0.2	13	18	25		0.2	15	22	31
0.3	29	40	57		0.3	34	49	69
0.4	51	72	102		0.4	61	87	122
0.5	79	112	159		0.5	96	135	191
0.6	114	162	229		0.6	138	195	275
0.7	156	220	311		0.7	187	265	375
0.8	203	287	406		0.8	245	346	490
0.9	257	364	514		0.9	310	438	620
1.0	317	449	635		1.0	383	541	765

Unfortunately, history has shown that while hydraulic elevators have provided safe transportation for many years there are situations that cause hydraulic elevators to descend at dangerous speeds resulting in severe injury and in some cases fatalities.

Hydraulic Elevator Design

Oil Hydraulic Elevators are raised by forcing oil through a hydraulic valve into a hydraulic cylinder underground and forcing a plunger upward supporting the elevator cab. To move the cab in the downward direction the down coil is energized to open the down valve and oil is forced out of the cylinder by the weight of the plunger and the cab. The movement in the downward direction is controlled by the amount of oil allowed to pass through the hydraulic valve. The elevator carries the majority of the load in the

elevator pit floor and cylinder. Unlike traction elevators very little of the hydraulic elevator's load is carried by the building structure above the pit.

Since hydraulic elevators do not require the load bearing structure that traction elevators require, it is less expensive to install in a building and is often more economical to operate. Today it would not be economical to add conventional safeties because building structures are usually not capable of withstanding the safeties setting a fully loaded hydraulic elevator. Even if the building structure were capable of handling traction safeties, the cost would be tremendous because the safeties add considerable weight to the elevator requiring an overhaul of the pumping system.

History

Hydraulic Elevators

For the first 100 years of the commercial elevator industry, hydraulic elevators represented a small minority of all elevator installations. Generally, the hydraulic elevators installed during the first half of the 20th century were primarily found in industrial locations for freight applications. As the industry evolved, hydraulic elevators began to play a greater role in the elevator industry in the low-rise passenger segment. Since hydraulic elevators require less structural support from the building, the cost of constructing a new building could be improved by installing hydraulic elevators. However, since hydraulic elevators are slow in comparison to traction counter parts, they were initially reserved for buildings with four floors or less. Since then, technology has advanced and hydraulic elevators serve up to eight stops and can handle increased capacity.

Concern over hydraulic safety has alerted the elevator industry a number of times over the years. Hydraulic cylinders are buried in the ground and go down as far as the elevator is expected to raise the car. Two issues arise out of this design. First, the earth surrounding the buried cylinder is unpredictable due to varying soil conditions. Second the inability to monitor the condition of the underground cylinder without removing it entirely. Removing a cylinder is extremely expensive.

In the early 1970's, several GM executives were injured in a hydraulic elevator when the cylinder blew out. This accident caused the elevator industry to look seriously for a solution. In 1971, the elevator ANSI Safety Committee instituted a code to require a safety bulkhead to the cylinder bottom of all new installations of hydraulic elevators. While this added some measure of safety to installations after 1972, the only way to improve the safety of an existing hydraulic elevator was to replace the cylinder. However, the safety bulkhead added to the bottom of the cylinder only helps when there is a catastrophic failure at the bottom. The safety bulkhead does nothing in the event of cylinder erosion due to electrolysis on the side of the cylinder or in the event of valve or hydraulic line breakage. It was believed by the evidence at hand then, that the double

bulkhead would solve the problem, however numerous cylinders with the second bulkhead have failed.

The *LifeJacket* for Hydraulic Elevators is a Life Safety System that was invented in 1995 and it protects elevator passengers in the same manner that the "Safety" does in traction applications without causing damage to the hydraulic plunger or building structure.

Accidents

Summary of hydraulic elevator accidents and significant events

1) The 1971 Elevator World article entitled "Cylinder Failure" listed several accidents and facts. General Motors plant, hydraulic elevator falls injuring thirteen executives

2) January 11, 1978; It was established that the cause of the elevators' failure was a leak of the oil from the cylinder underground.

3) On November 20, 1994, A gate valve broke and the elevator fell one floor.

4) On June 28, 1994 the Cincinnati Enquirer reported that on June 25, 1994 one person was killed instantly, another dies later and seven others are seriously injured when a hydraulic elevator plunges fifty feet in Indian Creek Apartments, Sycamore, Ohio. The elevator had passed every mechanical test required since its installation twenty-two years ago.

5) January 2, 1997**,** catastrophic failure of the hydraulic cylinder.

6) December 19, 1995, Investigation showed that the bottom of the cylinder corroded and blew away.

7) December 21, 1997 letter from Ken Garst, Universal Elevator "I am very fortunate to have (sic) survived an accident where a hydraulic elevator fell. This accident was not caused by the infamous single bottom cylinder, rather an elevator that was "bound" in the cylinder packing. I stepped down about 3 feet into the elevator to troubleshoot an open car stop switch, and my weight caused the elevator to break free and plunger approximately 16 feet where the plunger once again hit oil within the system. This actually caused the elevator to shoot back up about 8 feet, and then went back down to where the elevator car stopped when it hit the oil within the system. This happened within a few short seconds. It was extremely violent, and I just remember being tossed around like a rag doll. The injuries were various, from shattered ankles, broken heels, multiple fractures within both feet (too many to

count) and a fractured vertebrae. I am very familiar with hydraulic elevators and never expected this kind of accident to happen to anyone - especially me."

8) January 7, 1998: the bottom blew out of the cylinder with no advance warning such as: 1) adding oil at intervals & 2) oscillating sporadically at terminal landings.

9) Two crushed by falling elevator
… Fire Chief A.D. Bell said a hydraulic line used to hold up the car might have broken and caused the elevator to fall.

10) In 1987, a hydraulic elevator at the Omni Hotel in Jacksonville Florida was utterly destroyed when shortly after the elevator was built the head came apart and the elevator accelerated and crashed into the buffers causing the entire elevator to be replaced.

11) In 1995, in Burlingame California the bottom of an elevator burst

12) July 24, 1998, a department store near Atlanta Georgia equipped with a *LifeJacket* prevented the fall of an elevator after the mechanic determined that the underground piping had burst.

13) August 1998, another department store with a *LifeJacket* installed operated after the bottom bulkhead broke away from the cylinder due to electrolysis in Columbus Georgia.

14) In December of 1998, on an elevator in Santa Ana, CA the lifejacket stopped a falling elevator. The overspeed was detected at over 190 fpm at the 6th floor. The *LifeJacket* stopped the elevator 5" below the 6th floor. An underground feed pipe was found to have burst.

15) In January 1999, New York City, a parking garage elevator plummeted to the pit with a parking attendant in the car's driver's seat. The accident report indicated that "the cylinder was damaged and the oil leaked out. The elevator was severely damaged. The parking attendant was taken to the hospital.

16) August 1999 issue of Elevator World:
… The elevator had been installed in the early 1990's and elevator experts in the region note causes may stem from a problem with the normal braking systems and possibly with a back-up braking system, such as the over speed safety brake, the slowdown switch, etc.

17) September 27, 1999 Lafayette, LA.the elevator descended and … a valve regulating hydraulic fluid burst at about 11 am and the elevator car began going down.

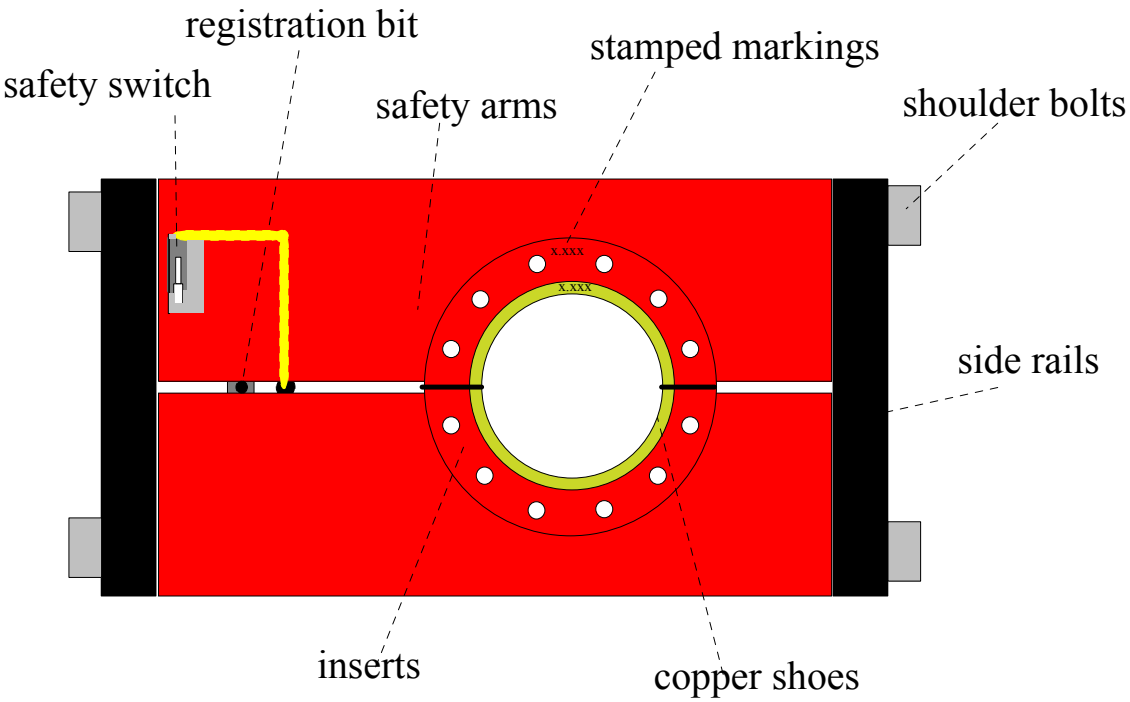
Accident Summary

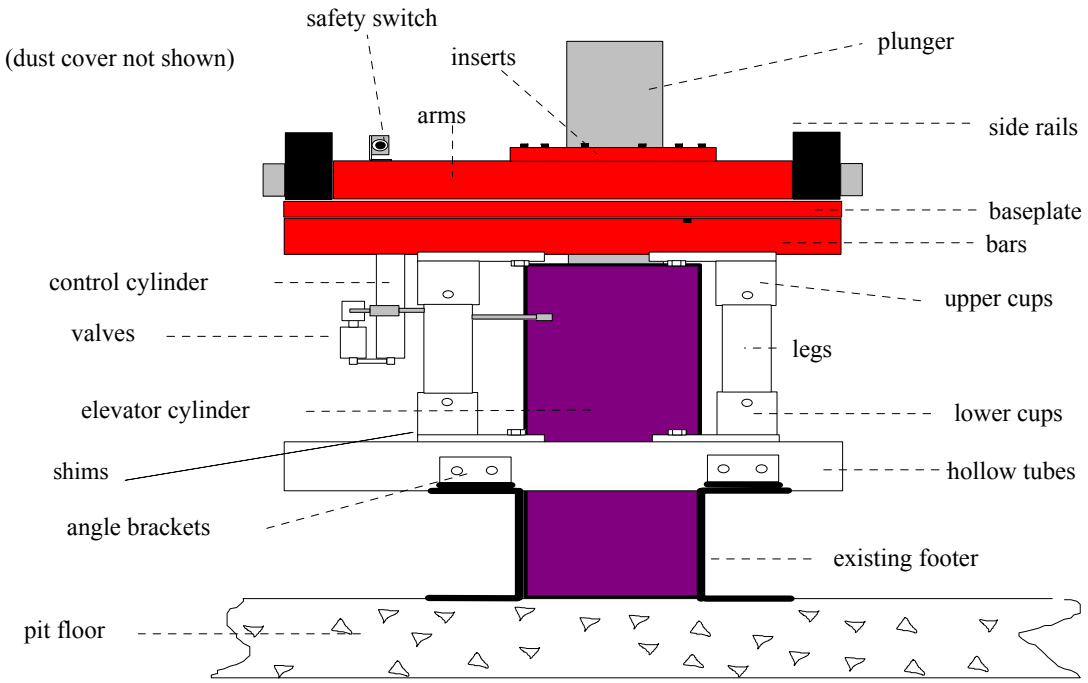
Replacing the jack does not eliminate all the hazards. A substantial number of hydraulic systems failures causing the car to fall are from plumbing component failure. The accident reports show packing, gate valves, vitaulic fittings, pipe ruptures, control valves have caused cars to fall catastrophically.

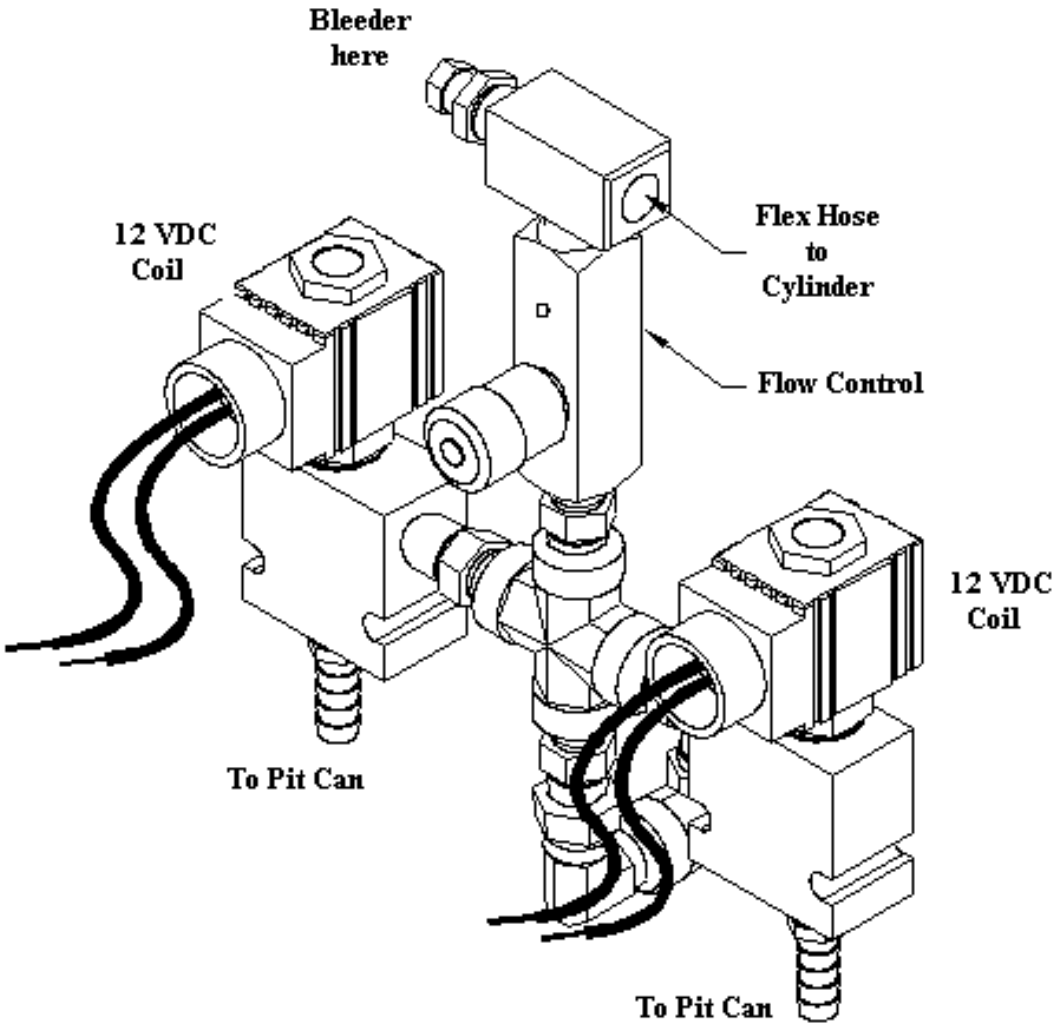
While replacing single bottom cylinders is ecological and increases the level of safety its does not provide protection from all type of failures like a true safety device.

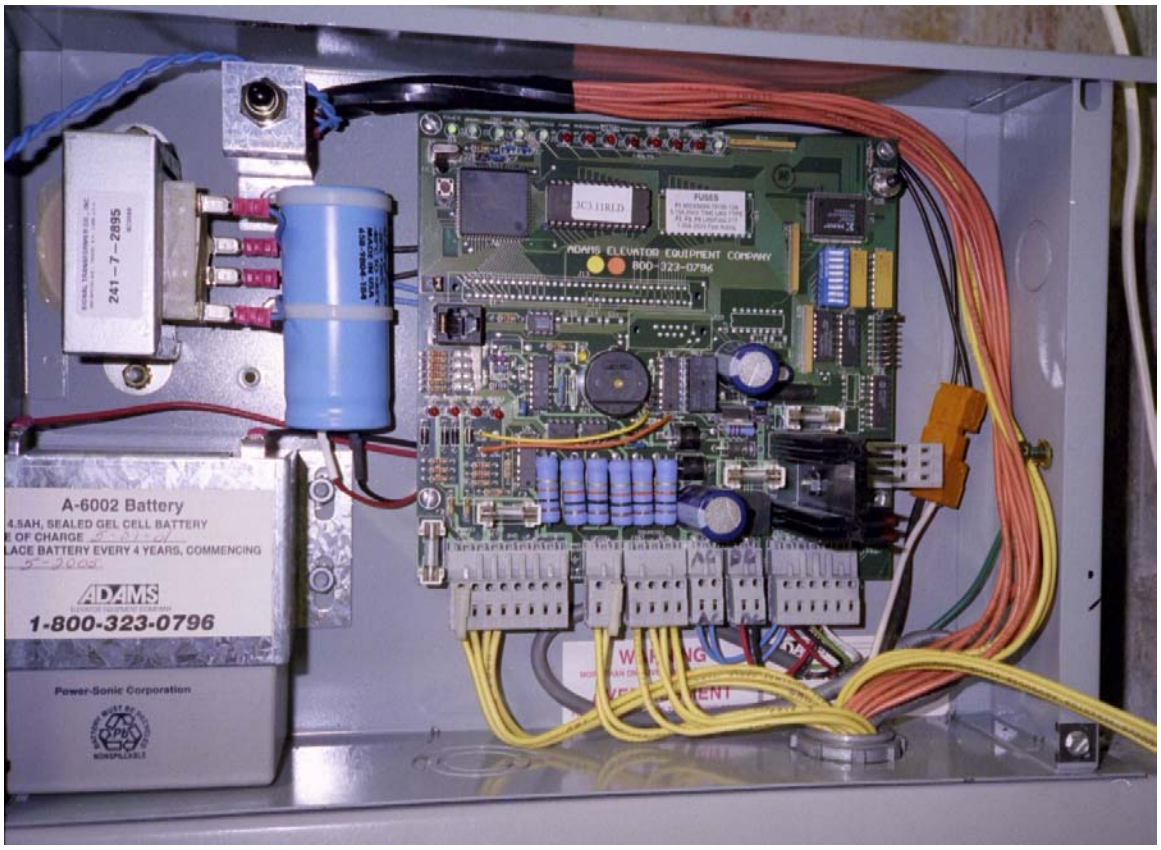
LifeJacket Design and Testing

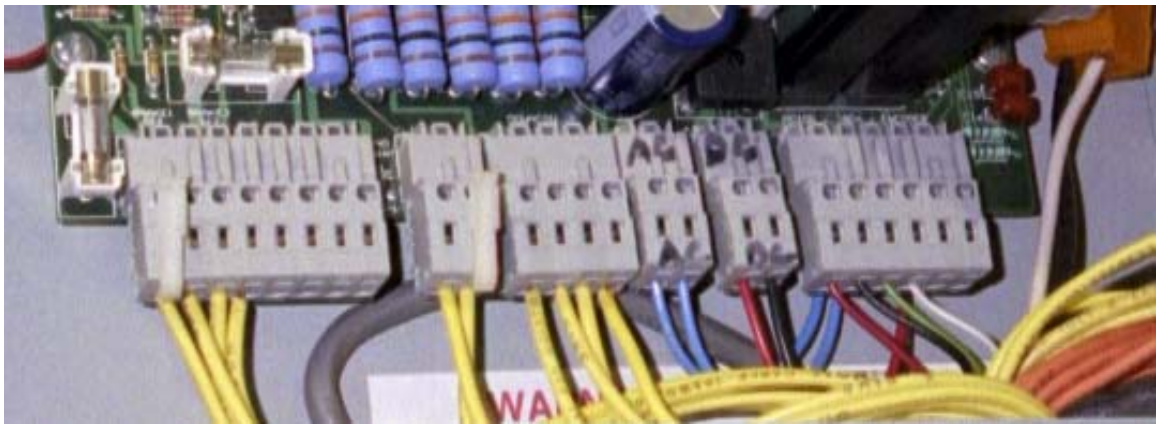
Construction








241-7-2895
ADAMS ELEVATOR EQUIPMENT COMPANY
A-6002 Battery
4.5AH, SEALED GEL CELL BATTERY
ADAMS
1-800-323-0796
Power-Sonic Corporation



Operation

The *LifeJacket* is a mechanical safety device with redundant electrical backup to protect passengers from catastrophic failures of hydraulic systems. The *LifeJacket*'s arms are held in the open position by hydraulic oil pressure. Any loss of pressure in the control cylinder will hydro-mechanically cause the *LifeJacket* to close around the plunger and prevent the elevator from moving in the downward direction.

The electrical components of the *LifeJacket* cause the mechanical arms to set when it detects lack of voltage to the down coil and the car is traveling in the down direction or if the car over speeds in the downward direction at a rate above code requirements or when self-diagnostics indicate elevator safety cannot be maintained, i.e. encoder failure.

In the event of power loss, the *LifeJacket* will revert to emergency power if available or its own battery power. The battery is rated for four years and will supply power approximately four days without utility power.

Certified Computer Analysis

AEA Technologies provided a range of structural testing services to solve complex static and dynamic problems. These services enabled us to achieve maximum equipment efficiency as well as optimum product design and reliability. Utilizing simultaneous, multi-channel, data acquisition equipment, AEA specialists eliminate the need for costly trial and error or build and test methods in order to obtain an effective solution to any problem.

A finite element computer analysis was performed to ensure the components used in the design of the LifeJacket were structurally adequate. An accompanying strain gauge test was also performed on a functioning LifeJacket assembly to provide additional information on the deflections and stresses as well as to aid in the correlation of the computer results. An AEA report was generated and its results summarized below.

The results indicate that the elevator plunger is not overloaded and will not collapse under the gripping load applied by the LifeJacket. The results also show that the assembly components are adequately designed to carry the loads developed during the braking process. (Note: Subsequent test and analysis results from AEA necessitated changes to achieve the required safety factors, which were incorporated into the production and beta models). A factor of safety greater than three and one-half (3.5) is achieved by all the components.

"From these results it is concluded that the brake (sic safety) *reacts as designed, and the plunger is not overloaded during the braking operation."*

"For the case considered in the computer analysis, the results show that Net Bearing Stress is but 10% of the Material Yield Strength, so this criteria is easily met."

Accelerometer tests were performed as well, in no case were the deceleration's greater than .55g's, well below the ASME A17.1 Elevator Code limitation of one (1) G.

Certified Lab Tests

The *LifeJacket* was tested in September of 1996 at Construction Technology Laboratories, Inc. (CTL), located in Skokie Illinois. CTL is one of the largest technology centers in the world dedicated to research, specializing in consulting and testing. CTL uses state of the art equipment to solve problems in the areas of building and bridge structures, pavements, piping systems, thermal behavior, transportation vehicles, mechanical systems, materials, and packaging. Specialized services for mechanical systems include physical performance evaluations. In the laboratory, instrumented measurements are electronically recorded as a mechanical system is subjected to operational and environmental extremes.

Some of the specific tests that were performed on the *LifeJacket* include the following:

Stopping force in reserve after plunger was stopped both with and without the presence of oil on the surfaces.

Starting with a known force of 12,000 pounds on a 4.5" plunger, repeating the tests to determine if the mechanism would allow slippage.

Over shimming the copper shoes, to determine if the mechanism would fail at the increased pressures.

Extremes of temperature, from -30 to +130 degrees Fahrenheit during the setting and holding of the *LifeJacket*.

Whether any permanent diametric changes occur to the plunger, and at what loads.

With the testing equipment able to push down a plunger at specified forces, it was possible to chart the stopping force and any slipping that occurred after stop. With oil present or not, the *LifeJacket* would stop initially, and any slipping would be at forces above the initially stopped load. The *LifeJacket* did not degrade its grip even with a constantly increasing load.

Using a constant force of 12,000 pounds on a 4.5" plunger, the *LifeJacket* was shimmed to stop the total force. Repeated cycling was done, over 1200 cycles, to determine the reliability of the *LifeJacket*, and to record the degradation of the stopping ability. The *LifeJacket* stopped the load for the entirety of the test.

Increasing the shims behind the copper shoe expectedly caused more deformation (hourglassing) of the plunger, but no amount of over-shimming caused any mechanical failure of the *LifeJacket* components.

Careful measurements were made to determine if any plunger deformation was occurring, and at what loads. We tested up to 6000 lbs. and found there were no permanent deformations at all, using the thinnest wall plunger material in common use, .188" nominal wall thickness. Clearly by these test results, the *LifeJacket* is safe to use, and test, year after year.

Beta Sites

Fifteen beta installations were completed from 1996 through 1997. From these installations we learned about plunger wall hardness causing difficulty in stopping full load and effects of over shimming. Pictures were taken and the installation manual improved several times.

Codes

Inquiry 96-70

Inquiry: 96-79 Subject: Direct-Plunger Hydraulic Elevator Safety Device Preface: Application of Rules to New Technology Introduction:
Section 2 - Purpose and Exceptions Rule 301.8, Car Safeties

The Preface section "Application of Rules to New Technology" clearly allows the enforcing authority to grant "exceptions where a product or system is equivalent in quality, strength or stability, fire resistance, effectiveness, durability, and safety to that intended by the present Code Rules."

Introduction, Section 2, Purpose and Exceptions, states:
The provisions of this Code are not intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety to those prescribed by this Code, provided that there is technical documentation to demonstrate the equivalency of the system, method, or device.

The specific requirements of this Code may be modified by the authority having jurisdiction based upon technical documentation or physical performance verification to allow alternative arrangements that will assure safety equivalent to that which would be provided by conformance to the corresponding requirements of this Code.

Question: assuming proper technical documentation and/or physical performance verification, may an authority having jurisdiction allow the use of one or more of the direct-plunger hydraulic elevator safety devices which have been developed?

Answer: Section 2 permits the authority having jurisdiction to allow alternate arrangements that will assure the safety equivalent to that which would be provided by conformance to the corresponding requirements of this Code.

A17 Committee Approval: March 12, 1997

A17.1a-2002

A17.1a-2002 Section 3.17.3 defines plunger grippers and describe its function in performance language.

plunger gripper -- a mechanical device attached to a supporting structure in the pit, which stops and holds the car by gripping the plunger.

3.17.3 Plunger Gripper
A plunger gripper shall be permitted to be provided for direct acting hydraulic elevators using hydraulic jacks equipped with plungers. A plunger gripper shall be capable of stopping and holding the car with its rated load from the actual measured tripping speed per Table 2.18.2.1 and shall conform to 3.17.3.1through 3.17.3.9. In Table 2.18.2.1 the words "rated speed" shall be replaced by "operating speed in the down direction".

A17.1 Section 8.6.5.8

Now that plunger grippers are defined their application can be added to other sections of the codes where they can be applied as a car safety.

There are code revisions in process to add plunger gripper options.

A17.1-200x 8.6.5.8 Safety Bulkhead. Hydraulic cylinders installed below ground shall conform to 3.18.3.4, or the car shall be provided with safeties conforming to 3.17.1 and guide rails, guide rail supports, and fastenings conforming to 3.23.1.

Plunger gripper use in seismically active regions is also being discussed.

Inspectors Manual

The Inspectors Manual Committee is working on LifeJacket (plunger gripper) additions to the manual.

Requirements

General

- Hydraulic Jack diameters 88.9 mm (3.5 inches) to 219 mm 8.625 inches
- 120VAC, 50/60 Hz, less than 30 watts
- 120 VAC to 12 VAC transformer supplied, if 120 volts not available, order 240 transformer, LJ4035.
- Elevator coil inputs 90 to 240 VAC/DC

Cabling

13 – 18 gauge conductors between LifeJacket controller and elevator controller.

9 - 18 gauge conductors between LifeJacket controller and LifeJacket safety mechanism in the pit, 5 conductors if a separate shielded cable used for set valves. Note, depending upon the distance from the machine room to the pit, set valves may require gauges larger than 18. Refer to Installation Manual Section 4.12.

4 – 18 gauge conductors unless controller is relay type. For relay controllers, shielded encoder cable is shipped with the LifeJacket. The encoder is low voltage, low power so depending upon electrical codes is your area, shielded cable may be run without conduit.

Relay Controllers

Because of the excessive electrical noise and high voltages induced into nearby conductors relay controllers require shielded cables for set valve and encoder wiring. Not using shielded cables does not cause immediate failures but eventually the LifeJacket control board will fail without an obvious cause.

4-conductor shielded cable for set valves
4-conductor shielded cable for encoder
Shipped with LifeJacket when survey indicates controller is relay type.

Troubleshooting Guide

There are two types of alarms generated by the LifeJacket: faults and warnings. Most alarms are faults detected and latched by the LifeJacket controller. Battery low and up over speed are warnings. Warnings are reset automatically. Faults are latched and must be cleared by pressing the RESTART button.

The following guide comes from the calls I have received and problems that have been encountered and fixed.

Battery

The LifeJacket controller charges and monitors a 12 volt battery designed to maintain operation for more than two days. Batteries are problematic. Their life and capacity are easily compromised by deep discharge, long storage (more than six months) with recharging, age, and heat. While a typical battery should last for four years, many will need replacing in as short as two years.

If for any reason battery capacity becomes low, the LifeJacket controller sounds an audible alarm. If AC power returns, the battery will charge and the alarm will turn off automatically.

If battery capacity continues to drop to a level where activating the set valves is not possible, the LifeJacket controller will latch a battery fault but will continue to operate as long as AC power is available. The instant AC power fails; the set valves are activated stopping the car.

Batteries leave Adams charged but depending upon installation schedules and storage temperatures they may have experienced enough self-discharging to activate the low battery alarm. Allow the LifeJacket controller to charge the battery for over six hours before suspecting a battery problem.

Capacity not Voltage

Monitoring is done by measuring battery voltage while a one amp-load is placed on the battery. This capacity measurement more accurately represents the true capacity of the battery than measuring no load voltage.

Heat

Some machine rooms are hot, especially during the summer. If the controller is a relay type with large hundred or thousand watt power resistors, mount the LifeJacket controller in the coolest part of the machine room.

At one job the LifeJacket controller was installed in a hot machine room on top of a cabinet containing power resistors. Battery replacement is every 18 to 24 months.

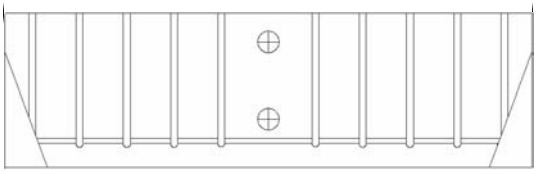
Car Does Not Stop

There are several reasons the LifeJacket may be unable to stop the car. All are encountered during installation and load testing. Accurate plunger diameter measurements during the survey process are critical. Shimming is effective for a limited thickness range and is primarily for adjusting for wear on the copper shoes.

Jaws and Shims

The jaws must lay flat against the base when gripping the plunger. If they do not, the car will not stop under full load. Section 8.5 of the installation describes a test using 0.005” shims supplied.

Although this was a minor problem on units manufactured before March 1998, it can indicate too many shims are installed or the inserts do not accurately fit the plunger. Re-measure plunger diameter and check measurement with the dimension stamped on the insert. The drawing below shows the irregular wear line on copper shoes when jaws do not lay flat.



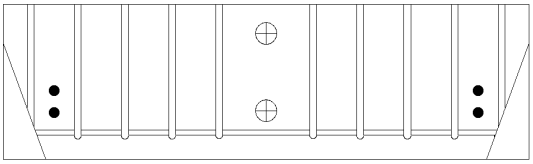
WEAR LINE

UNDER NO CIRCUMSTANCES ADD MORE THAN 0.030" of shim per side without calling Adams Customer Service. Over shimming and poorly sized inserts can damage the plunger.

Hard Plungers

We have experienced plungers with above average hardness which leads to a polished surface. The plunger smoothness can prevent the jaws from being pulled flat against the base so the car does not stop.

In cases like this, we send out jaws with special high friction pads that grip the plunger allowing it to pull the jaws flat for proper braking.



HIGH FRICTION PADS

Encoder

The LifeJacket encoder is actually a four-phase stepping motor used as a tach-generator. This provides a means to measure speed and direction with a device that does not draw power from the battery. It also has characteristics different from electronic encoders.

It does not measure speeds below eight feet per minute.

The internal magnets cause a rough feel when turning the shaft by hand.

A loose encoder cable can cause abnormally high speed readings and over speed sets. Solution, tighten the cable to the minimum of one inch spring extension. If the hatch has four or more landings, spring extension can be up to two inches.

Software version 3C3.10 was sensitive to releveling. If the car sat idle and releveled for several hours or more without making a single run and the releveling speed was below 8 fpm, an encoder fault set can happen. The solution is the no-charge upgrade to 3C3.11RLD.

Signals

The tach-generator (encoder) outputs an AC voltage proportional to rotational speed. Depending upon the speed of the car you can measure voltages from one to over fifteen volts.

The quadrature relationship between the two sets of windings allows the LifeJacket controller to determine car direction.

Speed Too High

As mentioned above, when the cable is too lose, speed measurements can be too high. The higher the hatch the greater the need for a tight cable.

On jobs with more than four landings it may be necessary to exceed the one inch spring stretch indicated in Section 2.14 of the installation manual.

Noise and Transients

The biggest noise producer comes from the cable bundle containing the elevator controller's safety circuit to the pit switch. On most old relay controllers this circuit is high voltage with currents over one amp. The currents flowing in the safety circuit induce voltages in near by cables. These induced voltages can exceed one thousand volts and damaged the twelve volt valve drivers on the LifeJacket controller.

LJ4010B

The LifeJacket controller is designed with voltage suppression but it has proven it is not capable of withstanding the transients generated continuously by old elevator controllers. LifeJacket control boards were damaged.

The LJ4010B Valve Driver Adapter PC board was designed to absorb all the damaging transients. It has been standard on all units shipped in the last three years. All LifeJackets installed with relay controllers should have LJ4010B installed.

Encoder

The encoder, due to its low impedance, is relative immune to induced noise and induced transients but we recommend and ship shielded cable on all jobs with a relay controller.

Set Valve Cable

If the survey indicates there is a relay controller, we ship four conductor, 16 gage shielded jacketed cable.

Set Valve Wiring

Because all wire drops voltage, its Ohm's Law, and the set valves must have 10.5 volts to guarantee operation, wire gage to the set valves is important.

Use the chart below to find the required wire gage for wiring from the 4 square box on the *LifeJacket* leg to the *LifeJacket* controller box. Connect the wires to their appropriate Wago type connector:

Connect 2 (two) wires to set valve 1 coil (use chart)
Connect 2 (two) wires to set valve 2 coil (use chart)
Connect 1 (one) for ground, 18 gage
Connect 2 (two) to the safety switch, 18 gage

MAX DISTANCE LifeJacket CONTROLLER TO PIT	SET VALVE WIRING USE THIS WIRE GAGE
70 ft	18
115 ft	16
180 ft	14
290 ft	12

Note: For distances greater than 290 feet, call Adams Technical Support at 800 323-0796.

Valve Coil Mounting

Over tightening the hex nut holding the coil to the valve body can damage the valve causing it to leak. The damage is not reversible by loosening the nut. The damage valve must be replaced.

Flow Control Valve

The flow control check valve shown above and in Section 8.3 of the installation manual allows oil to flow unimpeded from the activation cylinder for a fast set. When the system repressurizes the check valve prevents oil flow into the activation cylinder forcing it through the flow restricted portion so the jaws rise slowly.

When properly adjusted the jaws must drop instantly around the plunger and rise to full extension in one to two seconds. Adjustment is made by turning the knurled knob. Please

note, there is a set screw locking the knob in position. Loosen the set screw before making any adjustments.

Clock-wise rotation of the knob closes the flow control reducing the flow of oil causing the jaws to rise more slowly.

Direction Errors

Direction errors are produced when the car direction, as measured by the LifeJacket encoder, does not match the active elevator valve input on the LifeJacket controller. For example, the up coil input is active indicating the elevator controller is intending to send the car up, but the LifeJacket encoder measures a down direction.

Another example is when the LifeJacket controller measures a direction but elevator coil inputs are active.

Direction errors most often occur during installation before the LifeJacket controller is properly adjusted.

Sets Limits

Lab and beta site testing confirmed the copper shoes withstand over fifty full load full speed sets and still stop the car safely. To ensure the LifeJacket will always be able to stop the car, it counts the number of sets. When fifty sets are reached it sounds an alarm indicating full load testing is required.

After full load testing and possible re-shimming, the counter is manually reset turning off the alarm.

Installing – Removing EPROM

Remove J11 (BRAKE1 SET/BRAKE2 SET) connector.

Remove power from the Life Jacket board by removing J6 (AC XFMR) and J7 (BATTERY). Wait until the LEDs on the board go out.

Touch a grounded surface like the metal enclosure to dissipate static.

With a screwdriver, gently pry the old EPROM from the socket (U12).

Install the new EPROM in the socket with the notch toward the right, towards the Restart Switch. Insure that none of the leads have bent under the IC.

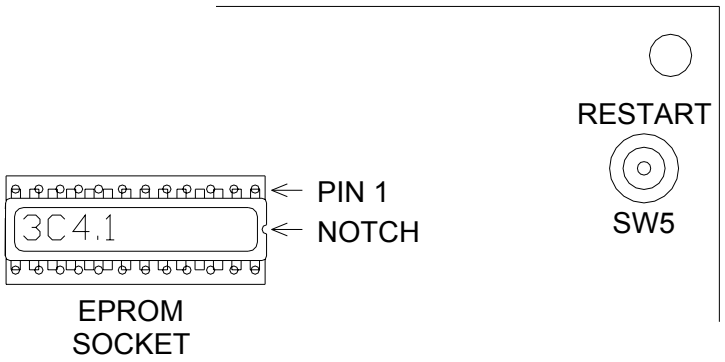
Reinstall J11 (BRAKE1 SET/BRAKE2 SET) connector.

Reinstall J7 (BATTERY) and the Life Jacket should give one long tone followed by four short tones. The In Service LED must be flashing. If you do not get this tone sequence or

the LED does not flash, remove the J7 BATTERY) connector and call Adams Elevator Customer Service.

If you heard the tones, reinstall J6 (AC XFMR) connector. D3, the power LED, must come on.

The installation is complete.



LJ4050 Information Display

The state of Michigan wanted a display to be mounted in the cover of every LifeJacket controller. The display would allow an inspector to walk into the machine room and instantly see the operating condition of the LifeJacket.

The information display includes number of sets since last servicing, grand total sets since installation, operation condition, and over speed trip speed in fpm.

This display is mostly developed and additionally includes battery voltage in volts, encoder direction, software version, and re-levelings per minute. Re-levelings are considered a precursor to hydraulic failures. Production availability is not scheduled at this time.

Surveys and Proposals

Quick Survey of Critical Dimensions

Purpose: To determine quickly and with the least amount of effort, the applicability of the LifeJacket.

Procedure: Measure the **Plunger Diameter**, **Runby**, **Strike Clearance**, **Buffer Stroke and Upper Flange Diameter**. (See FIG 1) These cursory measurements will provide enough information to determine if a LifeJacket will fit into the space above the head. The maintenance mechanic can do it during his normal visit and will need a decimal diameter tape and a tape measure.

Advantage: TimeSavings. Prevents a full survey that can take up to 2 hours of a mechanic and salespersons' time.

Disadvantage: A complete survey must be completed before ordering the LifeJacket.

Options: Should the LifeJacket not fit into the existing strike space, the customer could be offered a complete head replacement if there is overtravel room. At this time, there are no other options.

Initial LifeJacket Sales Customer Contact

Purpose: If the initial Quick survey determined that a LifeJacket is applicable, customer contact should be the next step. If the customer is interested in a bid for the work, a **full survey must be done** to determine exact costs and scope of work.

If after a full survey it is determined that the LifeJacket cannot fit, a letter should be sent to the owner that explains the inapplicability of the LifeJacket recommending other actions to improve the safety of the elevator in the event of a cylinder or hydraulic systems failure.

Survey Procedure

Procedure: The full survey requires two persons, at least one should be an elevator mechanic. The measurer in the pit and one operating the car either from inside the car or from the machine room. The measurer must accurately record the dimensions required by the survey. A latest Survey must be obtained from Adams. It is a two-page survey, all recording is done on page 1, page two is a reference drawing. There is also a two-page survey for Otis Cast Head type of cylinders. Use the appropriate Survey.

All items on survey must be completely filled out

Diameter of the plunger must be measured with a **decimal diameter tape** with the dimensions recorded to three places, e.g. 5.445", to the thousandth. Do not record in fractions or less then three decimal places, e.g. do not write 5.0", write 5.000". There can be no doubt about the dimension. Replacement inserts and copper shoes cost around $400 US.

The **rise or travel** of the elevator is important, do not fudge or add ten feet to assure you get extra of something. This is the distance from the bottom floor sill to the top floor sill. The accuracy of this measurement affects the plunger stress calculations done and may cause the job to fail applicability.

Weight of empty car or **empty car pressure** is essential. If you have both it is better, but **one of them is mandatory**. Pressure should be taken with empty car at the bottom floor, either taken at the head or the valve.

Check a **Ship to:** location. Where do you want it shipped, the job or the shop.

Answer the **Special Delivery** instructions, e.g. do you need a truck with a Liftgate to unload the LifeJacket or do you have a forklift to unload it. Remember, a LifeJacket weights about 400 pounds, 181 kg.

Car top information is useful but not always there. If it is a job that you installed, it is worth the trouble of looking up this information from the job file. This data is key to being able to apply the LifeJacket. If you don't know the plunger wall thickness, we will assume the thinnest wall and you will get a request for verification or a no sale possible message. The wall thickness is very helpful.

Wall Thickness is very useful but without a car top data tag it is usually unavailable. In some cases, we may require the wall thickness to be determined. If wall thickness cannot be obtained, the application program assumes the thinnest wall material allowed by code. A wall thickness tester can be lent/leased to you in these rare cases.

Mark the survey legibly, the survey comes back to you with the LifeJacket so that in the event something doesn't fit, we all have the same sheet of paper to determine what the problem was. We urge you to survey correctly the first time.

Scope of Work

The costs of installation must be considered before a proposal is submitted. Some expenses are per job and may not be the same job to job.

LifeJacket: There are two sizes of LifeJacket assemblies. The small size fits Plunger sizes from 3" to 5". The large size fits Plunger sizes from 5.01" to 8". Contact Adams Safety Sales for pricing.

Buffers: In some cases, it may be necessary to move or modify the buffers. In most cases to date, the local companies have their own source of metal fabrication and do it there. These costs should be considered in the final proposal. Reuse of the springs is customary and may reduce the costs significantly.

Runby: In most cases, there is room to install the LifeJacket without reducing the Runby space. Sometimes the Runby space is reduced to less than Code allowances. **If Runby is reduced, this creates two action items**. The first is the addition of Buffer Extensions. (page 16 in Installation Manual) These will mount on the Strike Plates on the existing elevator and are supplied with the LifeJacket. The second action item involves the Code Authority having Jurisdiction over the job location. Several Jurisdictions are allowing variances to this Runby reduction, but if you are not sure where your inspector stands on the issue, call and ask. Adams has and will assist in convincing the Jurisdiction to allow, but we can not assure you that they will. Caveat your proposal to the customer with a clause to the effect that this proposal is subject to Code Allowance.

Code Considerations: There may be some Jurisdictions that have yet to see an installation. Because of this, there has been no ruling granted or any official word given. The LifeJacket does not violate any present code rules unless the Runby is reduced. Your jurisdiction must be notified that an installation is being proposed and their approval is sought, otherwise you may sell it and find that the Inspector will not allow it and might even red-tag the elevator if you install it without their knowledge. A call to the Jurisdiction must be made to confirm a positive ruling. If the installation is denied, get it in writing. Here is a fork in the road, there are two types of installations which are pertinent to code,

1) If the Runby is not reduced, there are no code violations, in which case the Jurisdiction has no legitimate code violation authority to deny, just their own authority. In this case, an argument should be made (tactfully) such that if an accident occurs, the jurisdiction may be at risk of liability. Most States are allowing LifeJacket installations. He may not be aware of this. Call Adams if the Jurisdiction will not allow, 1-800-323-0796 ask for the Safety Sales Department.

2) If the Runby is reduced, (to less than code minimum), this is a violation of Rule 300.8b (ANSI A17.1-1996) Minimum Bottom Runby. This necessitates a variance to install the LifeJacket. The same argument applies as in **1)** above, but granting variances is a bane to inspectors. Unless their comfort level is increased, they don't like to vary anything. Again, call Adams and let us know. We will attempt to convince the Jurisdiction to allow.

Permits: Unless you are **VERY** sure that the Jurisdiction does not require a permit for this work, apply for one. It is not a major alteration, because replacing the power supply or the driving machine (See A17 Definitions) is not within the scope of this work.

LifeJacket Access Device (LAD): Adams has developed a device to aid the installation of the LifeJacket. It is a nonproprietary tool that plugs into the LifeJacket controller and displays the status of the system, car speed, faults and allows you to push a button to set the LifeJacket for testing, re-inspection and landing the car. **The LAD can be used on every LifeJacket** without special software or password protection. Order LJ550.

Other Costs

Labor: recent installations have required approximately two team days if the machine room is adjacent to the lowest landing hatch wall. Wiring considerations must be allowed if the machine room is up or away from the hatch. If the machine room is remote (e.g. across the parking garage) the most time will be spent wiring the LifeJacket. At least 15 wires are required from the machine room, where the LifeJacket controller is mounted, to the hatch. Typically, a 19-multi conductor is run.

Piping and wiring: 3/4" EMT and fittings, electrical boxes, 1/2" flex and flex fittings and 19-conductor multi-wire are typical requirements. At least 15 wires are required from the machine room, where the LifeJacket Controller is mounted, to the hatch.

First job familiarity: there is a learning curve that happens with every new product. Extra time can be saved if the installer can view the LifeJacket installation video and read the manual prior to installation. The installation video is available free from Adams and is sent with every LifeJacket order. Extra copies are available. Just ask for installation video LJ555 and installation manual LJ560.

A sale video is also available. Ask for LJ565.

Jobs that require special engineering: e.g. plunger followers, corner post ... call Safety Sales Department for estimates.

Wet Pit Upgrade: If the pit is prone to flooding, there is extra cost for NEMA 4 rated wiring components.

Test Weights: the LifeJacket must be tested with full load.

Shipping Charges: The LifeJacket weighs about 400 lbs.

Buffer Extensions: If the Runby is reduced, we send a strike plate kit. Each kit is good for two springs, some jobs may have four springs, requiring two kits.

Permit Fees: Depending on your customer contract, permit fees may be applicable to you.

FAQ

Is the *LifeJacket* Guaranteed?

Adams' parts are warranted to be free from defects in material and workmanship for a period of 12 (twelve) months after receipt of shipment.

How hard is the stop, are there code issues?

The stop is less than .5 G of force. It is much softer than a traction safety set. It is well within code and human safety factor standards.

What is the lead time?

Lead-time is 4 weeks or less.

How hard is it to change the packing?

On most heads, the arms of the *LifeJacket* open and allow free access to the packing gland ring. With larger heads, the *LifeJacket* will have to be hung from the bolster when the car is landed.

Are there any legal issues if my customers don't buy them?

Not being an attorney I would recommend getting legal advice, but potentially if there is an accident and there are injuries that could have been prevented, the customer could be at a higher risk.

What happens if the wrong size is ordered?

Field survey forms that are accurately completed will help prevent this from occurring. These items are the manufactured per job and there is a cost to machine new inserts and copper shoes.

Is there a model sample for Demo?

Twelve-inch tall models showing the ***LifeJacket***, cylinder, plungers is available.

What are maintenance requirements?

Keep the unit clean and retest it once per year. Should any of the components require attention, the controller will alert the serviceperson by sounding an alarm.

How many times can the *LifeJacket* be set?

Unlimited. You just have to add shims after a given number of sets. After over 50 full load, full speed sets, the copper wears down and would require shimming.

How many units are installed, where?

Over 1250 units in North America, Canada, and the West Indies.

Are permits required to install?

Depends on your jurisdiction. In many jurisdictions, a permit is required. If the *LifeJacket* takes away your runby and is now below the legal limit, a variance will also be required. In some jurisdictions, the elevator division indicated they would always grant the variance, but it is on a case by case basis.

What if we have insufficient run by?

The *LifeJacket* requires about 5 3/4" (five and three quarter inches) of clear height above the cylinder head. If the runby doesn't meet this minimum, then you can't put it on. One solution that is reasonably economical is to replace the head on the cylinder. This has rarely happened.

Is there a training Video or CD/ROM available for *LifeJacket?*

Yes there is. An installation and sales videos are now available call and ask.

How important is it to measure for the survey?

Extremely. The measurements for the plunger have to be in 1000ths (thousandth's) and the pit depth and clearances must be to 1/16th". The data on the survey is critical for the proper application of the Safety. Any survey not ***COMPLETELY*** filled out

will be returned to you to be completely filled out. It is vital for the data to be accurate for prompt processing of the order and to prevent rework costs.

What is the best way to measure the plunger?

The best way to measure the plunger is with a decimal diameter tape, which is accurate enough for the application.

Is the reset button only in the pit?

No, if the *LifeJacket* controller box is mounted in the machine room. The controller can be mounted anywhere and we recommend in the machine room.

Does it open the safety circuit?

Yes, a positive acting switch located on the *LifeJacket* opens the safety circuit. For resetting there is a momentary switch mounted in the controller which will jump out the *LifeJacket* safety switch only to allow for easier and safer resetting. This doesn't require that any jumpers be carried to be unintentionally left on the controller.

Can you run up with the *LifeJacket* set?

Yes, if the hydraulic pressure system is still intact and enough pressure can be held to raise the elevator.

If the pit floods, what happens?

If the *LifeJacket* does become inundated, it is advisable to clean the device and test. The pivot bolts are lubricated with 'Never Seize' and should also be checked and re-lubricated. Replace the safety switch mounted on the LifeJacket jaws. All the piping should be checked as well as all the other pit devices.

Has there been any failure tests done?

Yes, hundreds of them, at the Schindler test tower in Randolph, NJ, at Construction Technology Laboratories Inc. (CTL) and at Adams.

If the *LifeJacket* fails what is a company's liability?

Any company and Adams' liability would be significant, just as if a safety on a traction elevator should fail. That's why we have gone to great lengths to test this device and assure we are putting on a safety product that will work every time.

Why not use a governor and safety?

Most buildings that have hydraulic elevators were not designed to handle the loads from a safety set. In addition, most of these installations used 8-pound rails, which would not accommodate a safety. Consider also the use of pipe or "omega" rails. There are no safeties designed for these applications. In addition, the added weight of a Safety Plank may cause the oil pressures to exceed present code.

If a cylinder is scratched, can you use *LifeJacket?*

Yes, a scratch that does not affect normal operation of packing, will not effect the *LifeJacket* from stopping and holding rated load in the car.

Is it rust protected?

Yes, the *LifeJacket* is rust protected.

Is the encoder waterproof?

No, that is why the encoder is mounted at the top of the hatch. However, the encoder doesn't have brushes or slip rings to worry about.

What is the clearance required between the car and the cylinder head?

The *LifeJacket* takes up 5-1/4" inches of space. The runby must be checked and if needed, buffer extensions must be added to prevent the car striking the *LifeJacket.* A variance may be required from the local building code authority. Typically pits with a depth of less than 4' will require a variance.

Man hours to install?

Conditions such as machine room distance from the pit, buffer clearance, and whether there is a pit valve may cost more time, but in the standard pit of proper clearances, about 16 hours the first time.

Can a *LifeJacket* be applied to a two plunger holeless?

No. *LifeJacket* was made for an in-ground single cylinder system.

Machine room mounting?

We are recommending that the controller be mounted in the machine room. This was mandated by several code authorities and will ease troubleshooting. If the machine room is greater than 88 meters (290 feet) from the hatch, call Adams Technical Support for more information.

Does oil on the plunger effect *LifeJacket* setting?

No, the *LifeJacket* has been tested with oil and water and the *LifeJacket* will still stop the car when properly installed.

How often do the copper shoes have to be replaced?

The shoes, never. If the *LifeJacket* was to have 50 (fifty) full load, full speed sets, a .005" shim would likely have to be added behind each shoe to hold rated load to replace the very minute copper that was worn off. It would take several hundred sets to wear the shoe enough before it would need replacement. We have never replaced copper shoes because of wear. In order to assure that the shoes are tested and function correctly, the controller will count the number of sets and warn via an LED and a tone to retest with full load and full speed. After the procedure is performed, the count can be reset to 0 (zero).

Will ASME (ANSI) require yearly testing?

At this time there is no ASME (ANSI) code does not address periodic test but it is logical to assume annual testing with full load testing less often. There has been balloted language written that reference testing requirements. However, we feel that eventually the *LifeJacket* would be tested similar to a traction type elevator Safety.

Will a low battery set the *LifeJacket?*

The *LifeJacket* will latch an alarm when battery capacity, not voltage, is approximately less than approximately 50%. However, note that at about 70% capacity a warning alarm will be heard warning that the battery needs to be changed. This warning will automatically shut off when the battery recharges.

If the *LifeJacket sets*, does a mechanic have to reset it?

Yes, a mechanic has to reset it.

If a hydro is on the stop ring and the *LifeJacket* is engaged because of loss of pressure, how is the *LifeJacket* disengaged?

The *LifeJacket* needs the plunger to be moving in the down direction to set. The *LifeJacket* could not set right at the stop ring. Therefore, it is impossible to be fully locked without running room to unset it.

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