AEMA Continuing Education
Vertical Platform Lifts
Drive Systems

Presented by:

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"Platform Lifts & Stairway Chairlifts"

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"Lifts for the Physically Disabled"

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"Elevating Devices Mechanic's Apprenticeship Program"

Class "A": Elevator & Lift Mechanic's License, Province of Ontario

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Today the subjects are

- **Driving Means**
- **Specifically:**

What the mechanic and /or Inspector should know about:

Platform Lift Screw Drives

Platform Lift Roped Hydraulic Drives

PLUS

LULA Elevators

The current version of the A18.1 Standard was published in 2005 and is still effective. The A18, unlike the A17, does not publish annual addenda. The A18 is on a three year publishing cycle similar to the A17. The next publication of the A18.1 will be in 2008.

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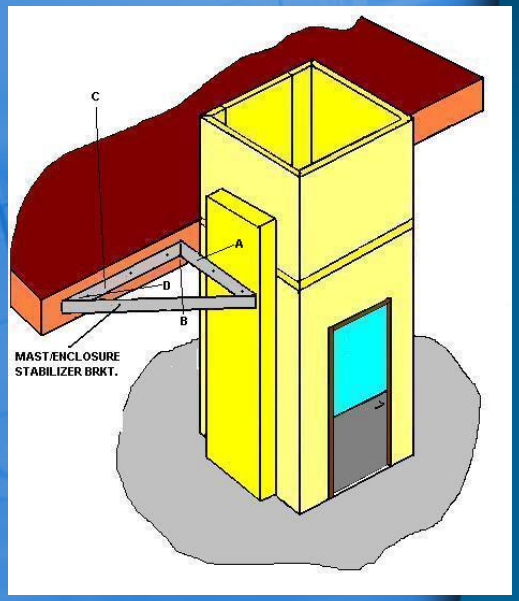
- **2.3 Driving Means and Sheaves**
- The driving means shall be one of the following:
- *(a)* winding drum
- *(b)* traction
- *(c)* roped sprocket
- *(d)* chain sprocket
- *(e)* **screw**
- *(f)* rack and pinion
- *(g)* direct-plunger hydraulic
- *(h)* **roped-hydraulic**
- *(i)* lever hydraulic
- *(j)* friction
- Driving means utilizing a combination of two or more means shall conform to all applicable requirements of the respective means unless stated otherwise.

The current A18.1-2005 Code section 2.3 listing the accepted drive systems for a Platform lift or stairway chair lift



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- **Screw Drives**
- **Conform to Section 8.2 of the A18.1.**
- Mostly engineering info but some sections of interest for the mechanic and inspector are:
- *Screw must be made of steel*
- *Nut must be bronze but equivalent materials may be used (materials with an elongation of 14%)*
- *Screws must be stable and maintained in position*
- *Safety factor is 5 (based total load)*
- *Special rules for screws that are joined.*

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•Definition:

•*Screw machine:* an electric driving machine, the motor of which drives a nut on a screw or rotates a screw to raise or lower a platform lift or stairway chairlift.

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- **Safeties and Governors 2.8**
- 2.8.1 has rules for Screw drives and the backup nut.
- A typical over-speed governor and safeties shall be used or one of the two following devices are acceptable…
- Speed cannot exceed 175fpm in the down direction in the event of a failure of the driving means.
- The carriage cannot fall further than ½” in the event of a failure of the driving nut by using a back-up nut or other means.

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- The rules state that engineering tests must be carried out to confirm that the speed restriction device performs as required or the backup nut performs as required.
- ***Drive nut failure cannot be simulated on site thus a safety test cannot be done by the inspector. It is permitted to have a test certificate from the manufacturer or a Professional Engineer certifying that the device operates as intended by the code. See section 9.6 of the A18.***
- Although not specifically required, most manufacturers will provide a safety switch that will cut off power to the motor and brake, if equipped, if the main drive nut fails and the carriage weight falls onto the back up nut for support.

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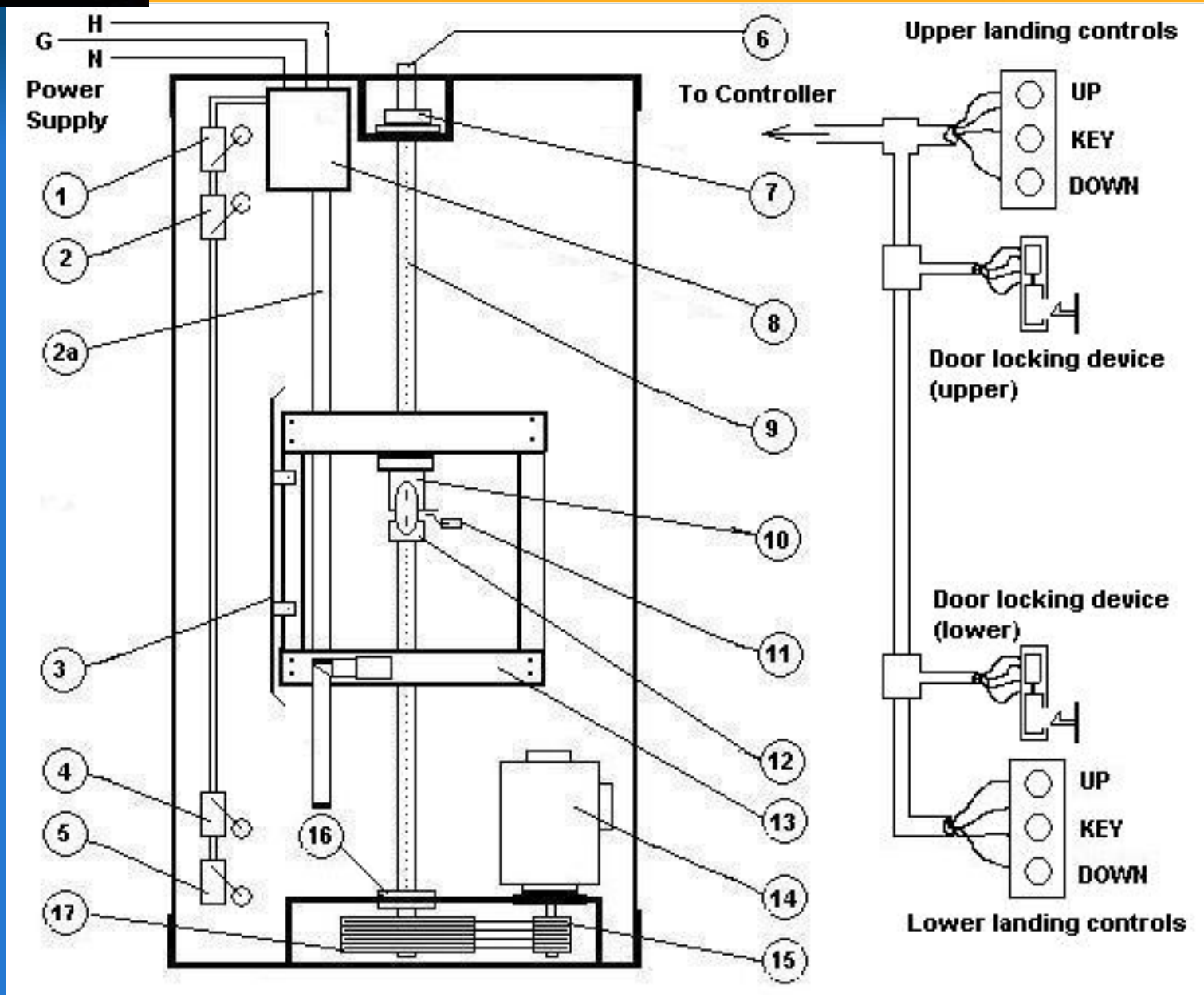

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- **Screw Drives (Re-circulating Ball Screw Drives and ACME screw drives.)**
- There are two types of drive screws used …Ball and Acme.
- Ball disappeared due to cost
- **High efficiency** kept motor size and electrical requirements low.
- Ball screw drives tended to over-speed in a failure thus..
- A governor and mechanical safety was required as well as…
- A machine brake.

•Re-circulating ball screw nut

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- Why are ACME screw drives so popular?
- Simplicity
- Cost
- Safety (5 x safety factor on gross load)

- No machine brake required
- No over-speed governor required
- No separate safeties required

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- If no machine brake…how does it stop?.....INEFFICIENCY!
- The efficiency rating is LOW…about 25 to 30%.
- What is efficiency? Basically if we put in 1 HP and we get 1 HP out then we have 100% efficiency. Can't happen! Why!
- FRICTION!
- The design of the screw and screw threads (pitch, angle and surface)
- The motor must work extra hard to rotate the screw (or turn the nut) to lift the load due to friction.
- Ball Screw E=95% Acme Screw-30%

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- **Most screw drives are driven by multiple belts**
- The code requires that drive belts be provided with monitoring safety switches (2.9.2)
- Are monitor switches required for an acme screw drive?
- Para 2.3.9 exempts belt monitors if the drive is “self-locking”. (Acme Screw)
- Ball screw drive requires monitoring switches.

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- If power removed when platform is descending with a load on an Acme screw, will the platform stop….

- IN A SHORTER DISTANCE?
- IN A LONGER DISTANCE?

- ANSWER: Shorter!!

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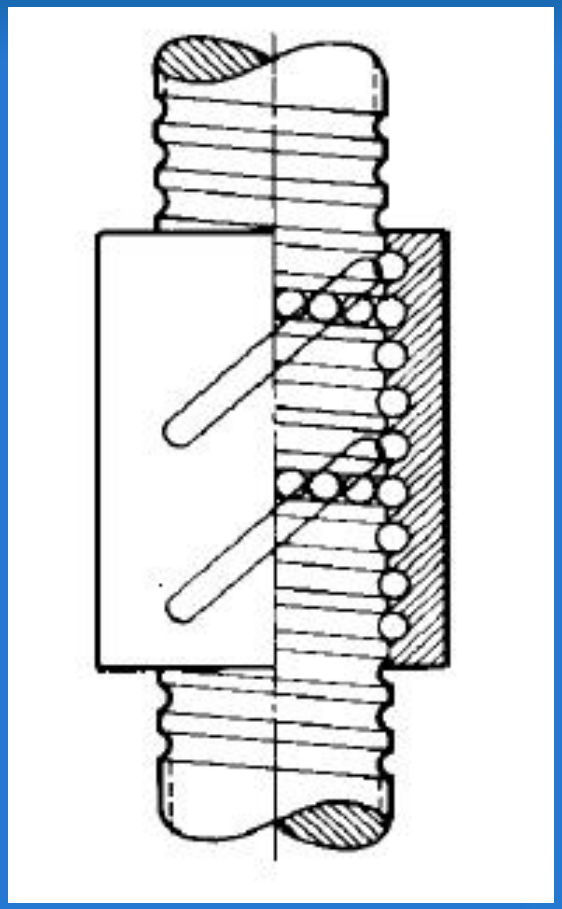
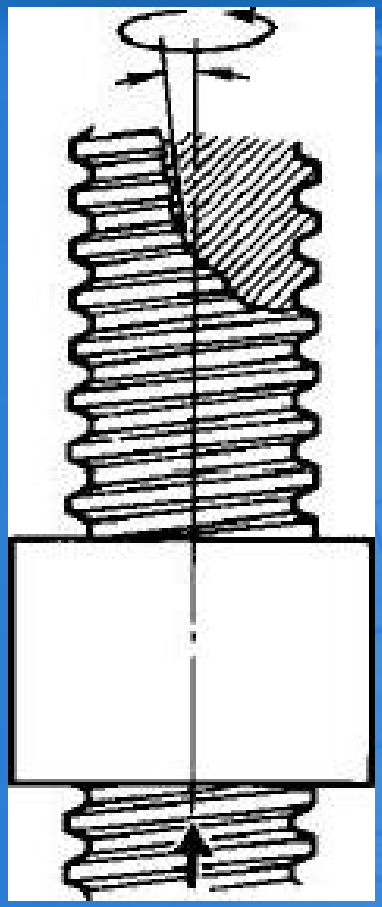


•Re-circulating Ball Screw Nut



•Acme screw nut

Re-circulating Ball Screw Nut

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- ***Ball Screws*** *are very similar to lead screws with the exception of a ball bearing train riding between the screw and nut in a re-circulating raceway. This raceway is generally lubricated, which allows for predictable service life. Due to the increased number of mating and moving parts, matching tolerances becomes more critical. The screw threads have rounded shapes to conform to the shape of the balls. The function, terminology, and formulas are the same as found with lead screws, however the performance of ball screws is far superior. The rolling action of the balls versus the sliding action of the ACME nut provides significant advantages. Advantages of ball screw drives are increased efficiency (typically up to 90 – 95%) which allows required motor horsepower and torque to be lower, predictable service life, low wear rate and maintenance costs. Ball screw drives are reputed to be the most efficient type of drive for low speed applications when comparing input horsepower to output horsepower available. Disadvantages include limited material choice, higher initial cost, and an auxiliary brake is required to prevent back driving with vertical applications*

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Lead screws *are threaded rods that are fitted with a nut. There are many types of threads used, but the most prevalent in industry is the ACME lead screw. Because the ACME thread is an industry standardized thread style, it is easily interchanged with parts from various manufacturers. The basic function of a screw is to convert rotary input motion to linear output motion. The nut is constrained from rotating with the screw, so as the screw is rotated the nut travels back and forth along the length of the shaft. The friction on the nut is a function of environment, lubrication, load, and duty cycle; therefore, practical life cycle is difficult to quantify. Lead screw/nut drive systems are available in a variety of sizes and tolerances. Contact is primarily sliding, resulting in relatively low efficiency and a wear rate proportional to usage. Advantages include the self-locking capability in back drive mode which is good for vertical applications, low initial costs, near silent operation, manufacturing ease, and a wide choice of a materials. Disadvantages of ACME screws include lower efficiencies (typically 30-50%, depending on nut preload) which require larger horsepower motors and drives and unpredictable service life.*

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- **How is the screw supported?**
- Like a hydraulic jack? (Compression)
- Like a block and tackle? (Tension)
- In nearly all applications for lifts, the screw is supported in **tension!**
- It “hangs” from the top bearing as the next two slides show?
- A Screw column is much stronger when loaded in tension rather than compression. The problem with compression is buckling of the screw column. (See handouts for data)
- A thrust type bearing at the top supports the screw and the load.
- The lower bearing is a “positioning bearing”.

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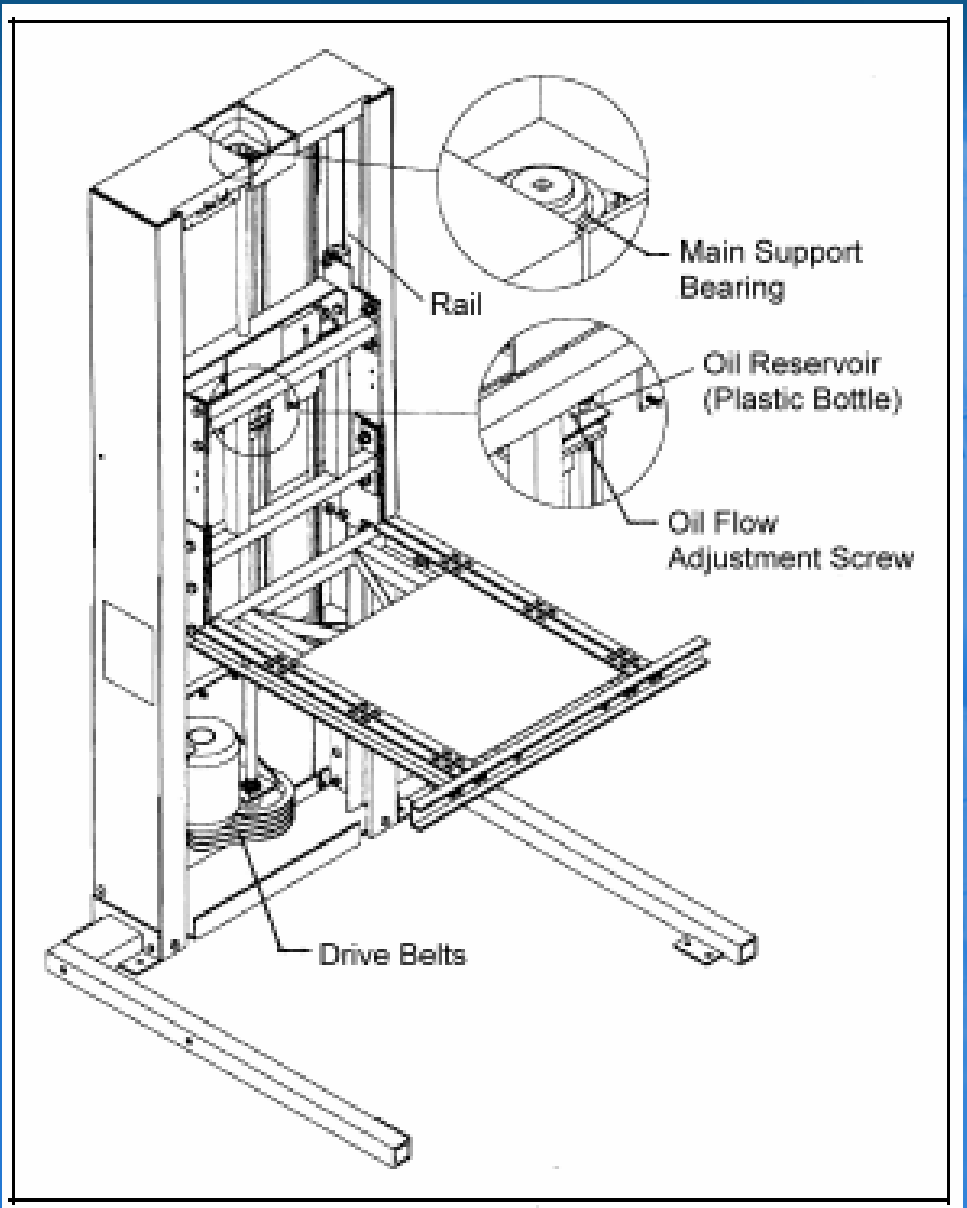

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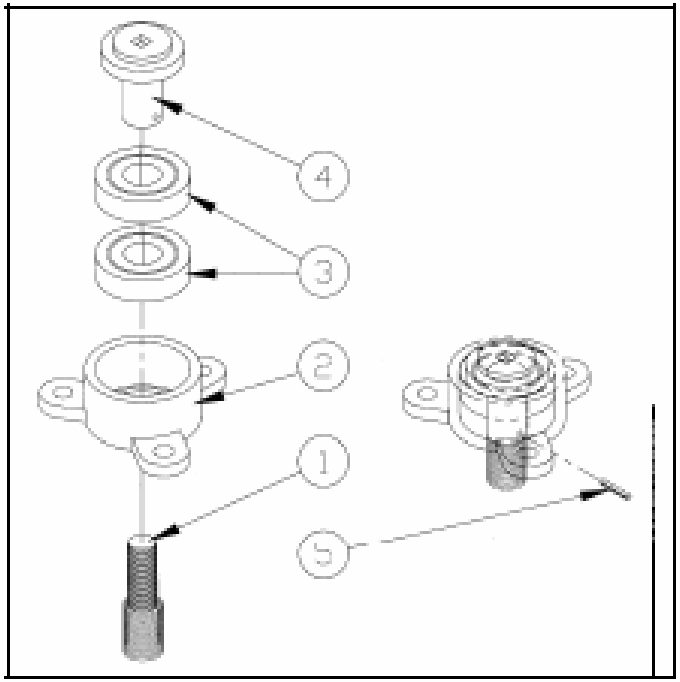
Concord HANDILIFT Vertical Wheelchair Platform Lift
Drawing Number 248054, Dated January 1996.

REF.	DESCRIPTION	QTY.	PART NUMBER
1	1" Dia. -5 Pitch Class 2G Acme Screw	1	248016
2	Thrust Bearing Flange Block	1	248003
3	25 mm ID Angular Contact Ball Bearing	2	102387
4	Thrust Adaptor Subassembly	1	248007
5	5/32" Dia. x 1" Spring Pin (End)	1	100542

MAIN DRIVE SCREW SUBASSEMBLY
Concord HANDILIFT Vertical Wheelchair Platform Lift
Drawing Number 248054, Dated January 1996.



SURFACE and FLUSH MOUNT CALL / SEND ASSEMBLIES

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Vertical Platform Lift

Purpose Designed

- **How does a backup or safety nut work?**
- Normally the main drive nut supports all the load.
- It is required to be a bronze nut or other material compatible with the Screw. Some plastics can also do the job!
- Backup nut “trails” behind the main nut and carries no load in normal operation
- Backup nut is “slaved” to the main nut
- Attached with a flexible or slotted bracket to allow main nut to drop onto backup nut if a failure happens
- Different designs available…some main nuts have built-in redundancy to act as a backup nut
- Safety cut-off switch.

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- Some designs use a steel nut
- Some designs use a retaining spring pin
- Remember…the backup nut or device is “unloaded” under normal operation

Vertical Platform Lift

Purpose Designed

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Unique solution to an accessibility problem (2 lifts in tandem)

- **Driving the screw!**
- Most designs of VPL use a motor rotating belts and pulleys to rotate the screw.
- Most VPL lifts travel at around 8-12 fpm. Why so slow?
- INEFFICIENCIES again!
- Usually 1 HP is the motor used. Ball Screw could be ¼ to 1/3 hp!!
- 1 HP motor will drive screw at the speeds stated.
- One way to increase the speed is to rotate the screw faster.
- *Because of length the screw cannot rotate faster than permitted by physical rules and the mfr. It will start to oscillate and self-destruct!*

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Enclosed Vertical Platform Lift

- **How do we get to the 9fpm typical speed.**
- ALWAYS REMEMBER THAT SPEED REQUIRES HORSEPOWER.
- No formulas…we are not designers or engineers just some basics.
- Typical ratio between motor pulley and screw pulley is 4:1.Motor is nominal 1800 rpm
- A motor rotating at 1725 rpm will turn the screw at 430 RPM. (1725 divide by 4).
- If the pitch of the screw (distance between threads) is about ¼ “ (.25”) then the nut will travel at what speed?
- One full turn of the screw causes the nut to move .25”

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Unenclosed Inclined Platform Lift

- 430 turns per minute of the screw will cause the nut to move at what speed?
- 430 turns times .25” equals 175 inches or about 9 FPM.

  SEE THE BALL AND ACME SCREW HANDOUTS FOR MORE INFORMATION ON THE TEHNICAL CHARACTERISTICS OF DRIVE SCREWS
- The customer says: It’s too slow…can we speed up the lift on site?
- Can we just put in a screw with a longer pitch?
- More HP required to do it!

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Unenclosed Inclined Platform Lift

- Some mfrs today offer a 30fpm screw drive…HOW!
- They drive the nut rather than the screw!
- The nut can be rotated a lot faster than the screw column!
- Requires the drive to be on the platform rather than as shown at the bottom or top of the screw column.
- More expensive method to get additional speed but some customers want it.

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Unenclosed Inclined Platform Lift (exterior Model)

- **LUBRICATION**
- The high friction in a screw drive plus contamination on the threads from the environment requires that the drive nut be continually lubricated.
- Many mfrs provide pre-loaded grease cartridges
- Some provide oil reservoirs.
- *IMPORTANT! The nut can fail catastrophically if regular maintenance of the lubricating system is not performed!*
- Always ensure a maintenance agreement with the customer is discussed and point out the requirements for regular checks of the lubrication system if the owner does his own. REVIEW THE OWNERS MANUAL WITH THE CUSTOMER!

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What did we learn?

- Why are ACME screw drives so popular
- Why we need so much HP to move an ACME screw compared to a Ball screw
- We learned about EFFICIENCY and how it affects speed and power
- The importance of proper lubrication for an ACME drive nut
- The reason why a machine brake, safeties and a governor are not required.
- How to field test a backup nut…NOT!!
- How a backup nut works in the drive system
- Code requirements for backup nuts

Unenclosed Inclined Platform Lift
(Curved Stairway Model)

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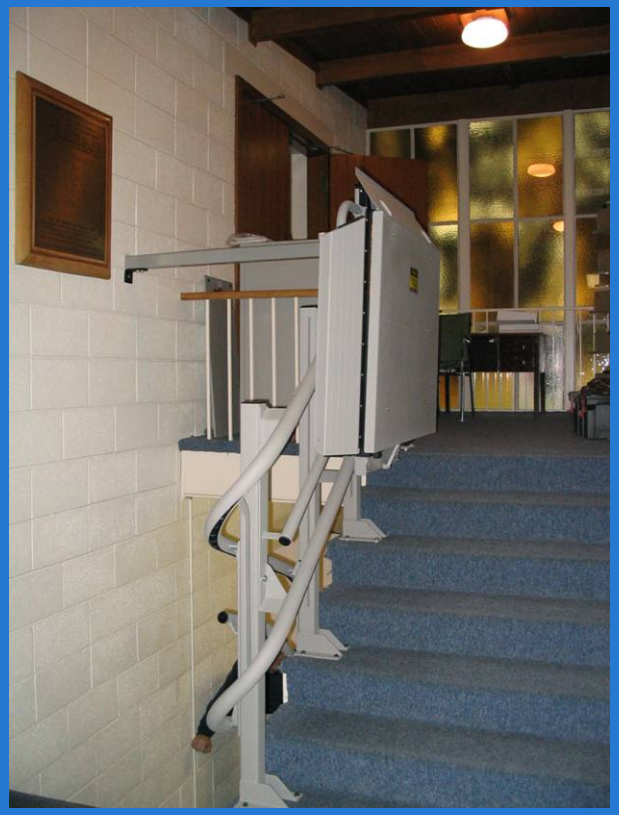

Unenclosed Inclined Platform Lift
(Curved Stairway Model)

- Thread pitch and its effect on speed
- Drive pulley ratios and their effect of speed
- Limitations of screw column rotation speed..
- TENSION loading of a screw column compared to compression and its affect on safety
- Why a typical screw drive is so slow
- Materials for drive nut and backup nut

- LET'S TALK ABOUT ROPED HYDRAULIC LIFTS

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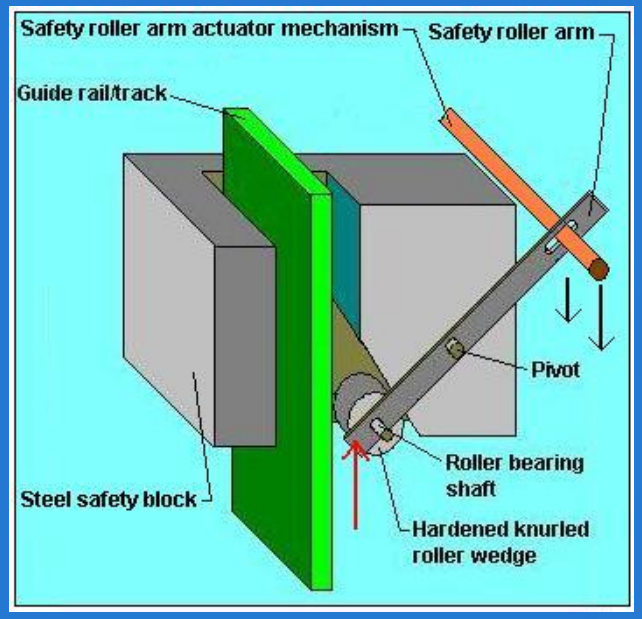

A version of TYPE "A" Safeties

- Section 8.1 covers Hydraulic and Roped Hydraulic drives.
- Extensive section
- Direct Acting hydraulic jacks 8.1.1
- Indirect acting hydraulic jacks 8.1.2 (Roped or Chain Hydro)
- 8.1.2.2 talks about an obsolete design
- A lot of engineering stuff again

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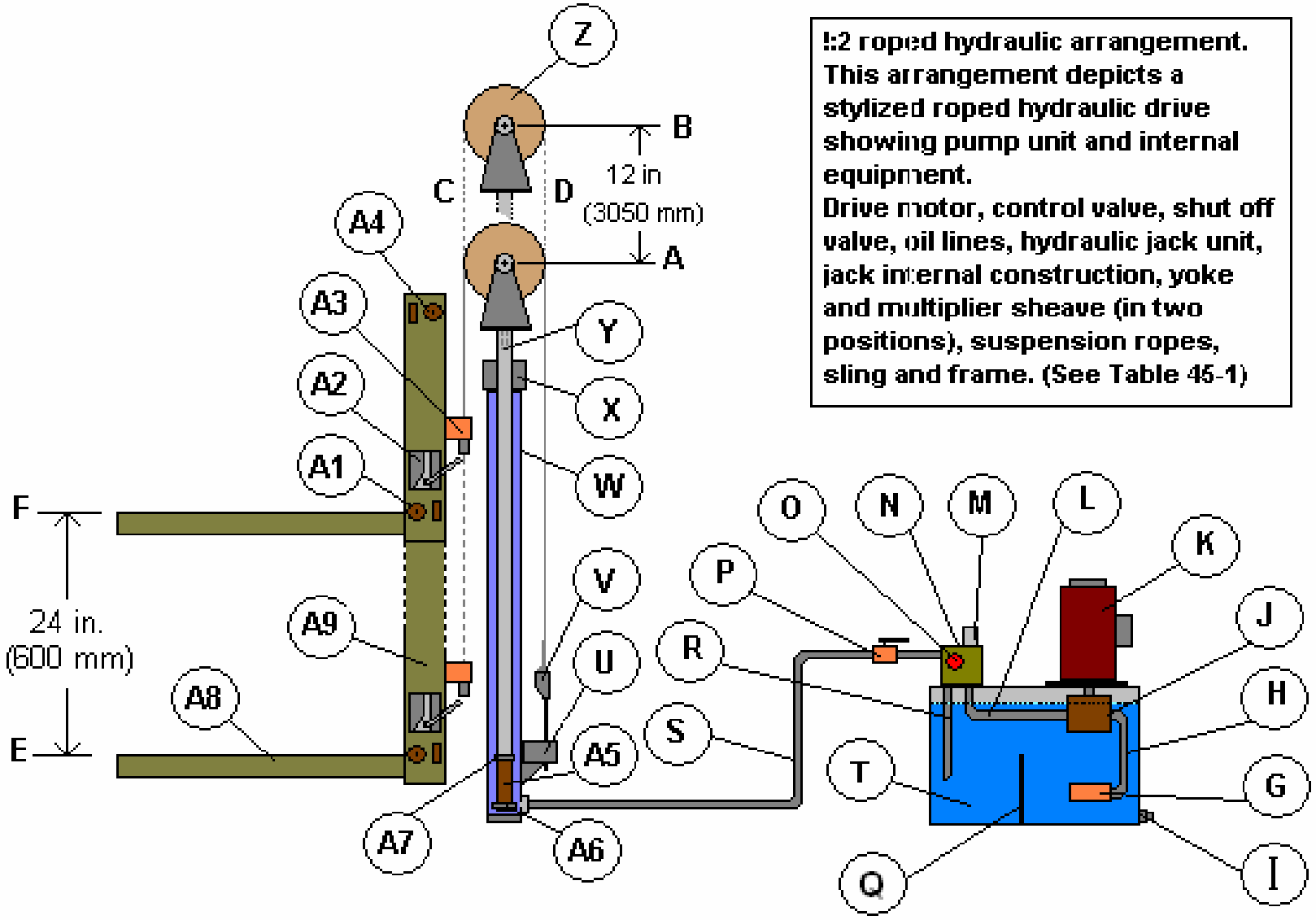

!:2 roped hydraulic arrangement. This arrangement depicts a stylized roped hydraulic drive showing pump unit and internal equipment.
Drive motor, control valve, shut off valve, oil lines, hydraulic jack unit, jack internal construction, yoke and multiplier sheave (in two positions), suspension ropes, sling and frame. (See Table 45-1)

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Item	COMMENT
A	Starting point for centerline of multiplier sheave (lowest point)
B	Finish point of centerline of multiplier sheave (upper point)
C	Wire rope on car side of multiplier sheave
D	Wire rope on dead end side of multiplier sheave
E	Starting point of platform support arms (lowest point)
F	Finish point of platform support arms (upper point)
G	Suction filter in oil reservoir
I	Drain Plug (Typically magnetic to catch metal particles)
H	Suction line; pump to oil filter
J	Submersed oil pump direct connected to motor
K	Pump motor (external mounted type shown).
L	Pressure line from pump to control valve.
M	Solenoid on control valve (Usually low voltage type used).
N	Control valve, unit type shown.
O	Manual lowering handle shown on face of control valve.
P	Main shut-off valve (For testing and maintenance)
Q	Tank baffle plate (To reduce turbulence in the tank)

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R	Oil return line to reservoir from relief valve and down direction valve.
S	Main oil line from pump shut-off valve to oil inlet at jack unit cylinder
T	Reservoir oil. Typically 32 grade (indoor); 22 grade (aircraft) exterior use.
U	Dead end wire rope fastening; attached to base of jack or upstand post
V	Rope wedge wire rope termination device
W	Jack cylinder
X	Jack cylinder head, contains seals, bleeder, scavenger and wiper
Y	Jack or ram size varies (for VPL typically 1.25 in to 1.75 in.
Z	Multiplier sheave; sometimes called a cathead or rope head
A1	Lower stile guide roller with back-up bracket (could also be guide shoes)
A2	Safety block (see figure 39) 2 req'd with actuator arm
A3	Sling cable termination and slack rope actuating assembly for safeties
A4	Upper sling guide roller and back-up bracket. (Could also be guide shoes)
A5	Stop tube at base of jack or ram (for jack stability when fully extended
A6	Guide at base of jack with wiper to reduce interior scarring of cylinder
A7	Stop ring. To prevent jack from leaving cylinder when fully extended
A8	Cantilever steel arms. To support entire platform enclosure and capacity
A9	Stiles. Structural support and guiding means for platform enclosure.

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•Why Roped (or chain) hydraulic and not direct hydraulic

- •Direct…..every foot of travel requires a foot of jack “and then some”
- •Roped (chain) hydraulic….every foot of travel requires only half a foot of jack!
- •The jack can stay within the mast and not require a borehole or extended height
- •Roped or chain terminology is 1:2 (One to Two) not 2:1 (Two to One)
- •Convention is “drive over driven”
- •Traction elevators with sheaves are 2:1
- •Nothing is free…1:2 Indirect Drive saves height but the carriage must have safeties
- •Direct does not require safeties
- •WHY??
- •What type of safeties are used on a 1:2 drive?
- •Instantaneous! (The elevator industry terms them “Type “A” Safeties.
- • Loss of suspension means usually means loss of “all or part of suspension means”
- •Safeties apply if slack rope/chain occurs or entire suspension lost)
- •What about a governor!

•Why Roped (or chain) hydraulic and not direct hydraulic

•Over-speed of the lift with suspension intact can only be possible (barring catastrophic failures) if the oil feed line fails.

•Code section 8.1.4.2 requires that a flow control be installed at the cylinder to prevent speed exceeding 125% of the rated speed if the oil line fails.

•Note that item “Z” on our list is the sheave or pulley mounted at the top of the jack. Its purpose is to provide the “mechanical advantage” we require in order to move the platform one foot for every two feet of platform movement.

•This **“multiplier sheave”** is subject to twice the gross load of the platform thus is sometimes quite heavy duty. Unless lifetime sealed bearings are used, it may require regular lubrication.

•The sheave or pulley must also be guided. This guide system will also require lubrication and the guide shoes or guiding devices on the sheave must be examined regularly.

•Cable or chain guards are required to ensure they cannot ever come out of the grooves or off the sprocket in the event of slack rope or chain . Examine regularly.

•OPERATION OF A DISPLACEMENT JACK

- There are many types of jacks
- Single acting jack
- Double acting jack
- Telescopic multi-stage sequential
- Displacement
- The one we use in the lift industry nearly always is the displacement jack
- Define “PLUNGER” and “PISTON”?
- Terms used interchangeably are arguably incorrect.
- Basically, plunger has no seals….piston has seals.
- Single acting and double acting and telescopic have seals on the moving “piston”.
- Displacement jacks have no seals on the “plunger” only in the head to prevent leakage.
- Why displacement?
- The jack goes out of the cylinder under pressure from the oil being pumped in
- The pressure inside the cylinder climbs as the motor pumps in oil until it exceeds the pressure exerted by the load on top of the plunger.

•OPERATION OF A DISPLACEMENT JACK

- Once the plunger or jack starts to move the oil continues to pump in to keep it moving and displaces the volume left by the exiting jack.
- NOTE: Mistakenly, some techs believe it is the area of the bottom of the plunger that is the critical area…the think the jack is being up by the bottom of the jack.
- The critical area is the area of the jack. As it was once explained: “It is the area of the jack that is leaving the cylinder that is the calculating factor”.
- To calculate speed, the area of the jack is most important.
- Formula: **Speed** of the jack is equal to the **flow** of the oil entering the jack divided by the **area** of the jack.
- No more formulas!

•WORKING PRESSURE

- In hydraulics, pressure is a common word
- Relief pressure
- Bypass pressure
- Static pressure
- Working pressure
- Flowing pressure
- Peer pressure (just kidding!!)
- They can be confusing!!
- Define the one the inspector wants to know…WORKING PRESSURE!
- PAUSE…….

•WORKING PRESSURE / RELIEF PRESSURE

• Working pressure is best defined as **"The pressure developed within the hydraulic system while the lift is operating in the UP direction at rated speed while carrying rated load"**

•The inspector wants to know this pressure so that he can write it down on his form and the technician can then do….what!!

•Set the relief valve! Every lift and elevator is provided with a relief valve which must be set either set on site or sealed at the factory. (Most inspectors will want a field test!)

•HOW!

•Need working pressure plus a pressure gauge.

•Load lift with full load and run the lift up at rated speed and observe and write down the pressure showing on the gauge.

•When the pressure is noted, the relief valve can be set to bypass the oil back to tank at a maximum of 150% of the noted working pressure. In many cases 125% will work fine but the maximum is 150%.

•WORKING PRESSURE / RELIEF PRESSURE

• Note that some inspectors may want to run the relief pressure up by closing the gate valve at the pump unit and some may want to **inch** the platform up until the jack is on the stop ring. (A mechanical stop attached to the end of the plunger/jack to prevent it from leaving the cylinder).

•Preferred Method (subject to the procedures of the local AHJ): With the platform at the bottom and zero pressure on the gauge, close the **main gate valve** at the pump unit.

•Then remove the cover of the **relief valve** and access the adjustment screw. Open the adjustment screw **3 or 4 turns to** reduce the bypass pressure on initial setting. (We don't know where it has been set at this point and we don't want to **stall the motor** and blow a fuse or worse!) Start the motor and observe the pressure gauge. Insert the adjustment tool into the adjustor and turn the adjustor (usually) clockwise slowly while the motor is running. As the screw is turned the tech will note the pressure rising on the gauge as he turns in the adjustor. Continue to turn the adjustor until the **indicated pressure** reaches the required bypass pressure. For example: if the working pressure is 500psi on the gauge and you want to set the relief valve at 125% then the chosen bypass pressure will be 500 times 1.25 or 625 psi. The maximum is 150%

WORKING PRESSURE / RELIEF PRESSURE/NEGATIVE PRESSURE

- Now an interesting note!

•A18 has no requirements for a over-pressure relief valve! However, nearly every inspector will want to test it in accordance with the “other code”. All mfrs provide a relief valve as “good engineering practice” thus it needs to be set.

•**Negative or Loss of Pressure device, switch or sensor.**

•This is another device not required by the A18 but is common on many. Home elevators, freight elevators, regular hydraulic elevators all require a negative pressure device in certain design situations. Many inspectors will look for it!

•It detects the lowering or loss of pressure within a hydraulic system and will then trip an electrical switch to prevent the operation of the lift in either direction.

•There is an adjustment screw on most models and the screw need only to be adjusted to the point where it will trip the electrical switch. The use of a VOM is good for this application. Remember that while there is pressure in the system, the switch must be closed to permit the elevator to run.

WORKING PRESSURE / RELIEF PRESSURE/NEGATIVE PRESSURE

- Place the leads onto the N/O contacts of the switch when the pressure is in the system
- The reading should show continuity.
- Now lower the platform or shut off the main gate valve and open the manual lowering valve to remove all pressure in the system.
- Now place the leads onto the N/O contacts again. There should be no continuity.
- If there is, adjust the screw as indicated in the manual until the procedure described works.
- The Negative pressure switch is intended to protect against the platform “hanging up” at a floor. This may happen if the jack seals are too tight and the platform sits a floor when there is a slight leak. It is possible that the seals will hold the platform at the floor and the oil pressure may leak away and thus the platform is not supported. If anyone would call the platform down at that time, it may descend quite fast due to lack of oil. The negative pressure switch is intended to shut of the down direction solenoids or valves to prevent this.

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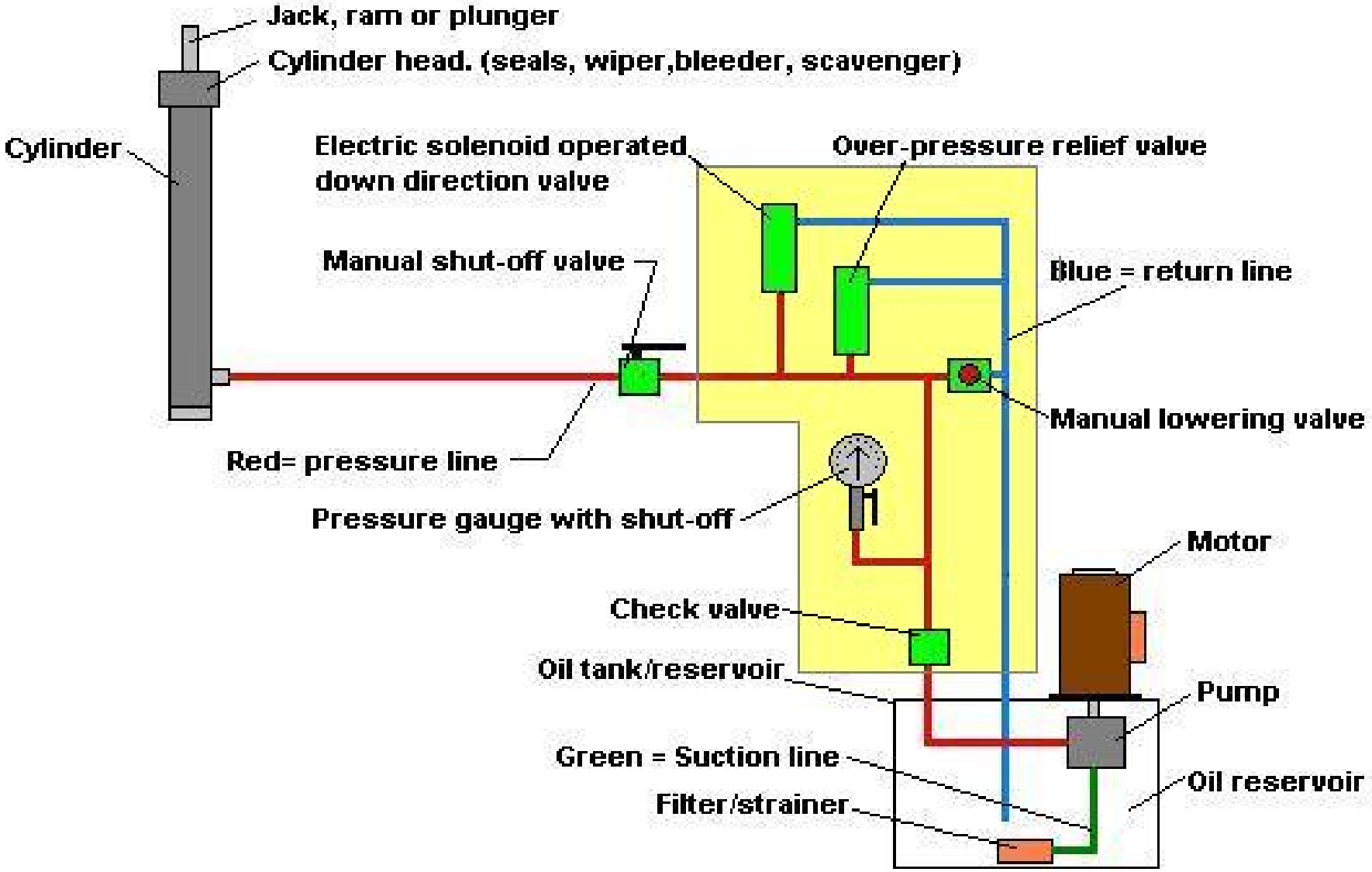

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- **PUMP TYPES AND FLOW RATES**
- Vane
- Screw
- Gear

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- Screw.. quiet but expensive. Pulsating flows at low rpm. Screw drive tends to need high rpm to maintain consistent flows.
- Gear … noisy but inexpensive smooth flows at high rpm. Most gear pumps are not suited to lifts due to noise, especially on a home. Positive flows and ready availability are advantageous.
- Vane …Mid-range; positive flow rates, fairly quiet, popular. Low rpm keeps motor noise and vibration down.

- **PUMP TYPES AND FLOW RATES**
- The speed of hydraulic lifts are set by the amount of oil flowing into the jack.
- The amount needed is directly related to size of jack and flow rate. In our previous discussion we stated that the speed of the jack (thus the platform) is related to flow and jack size and for roped hydraulic the multiplier sheave.
- Without getting into any more formulas, remember that the flow rate of the pump and the size of the jack diameter are related.
- If a pump is to be replaced, ensure that the flow rates are as shown on the pump or the lift may operate slower or faster
- If the motor is to be replaced make sure it is a direct replacement with the two nameplates matching exactly.
- An 1800 rpm motor must be replaced wit an 1800 rpm motor and the same HP and voltage and shaft size and feet mount, etc.

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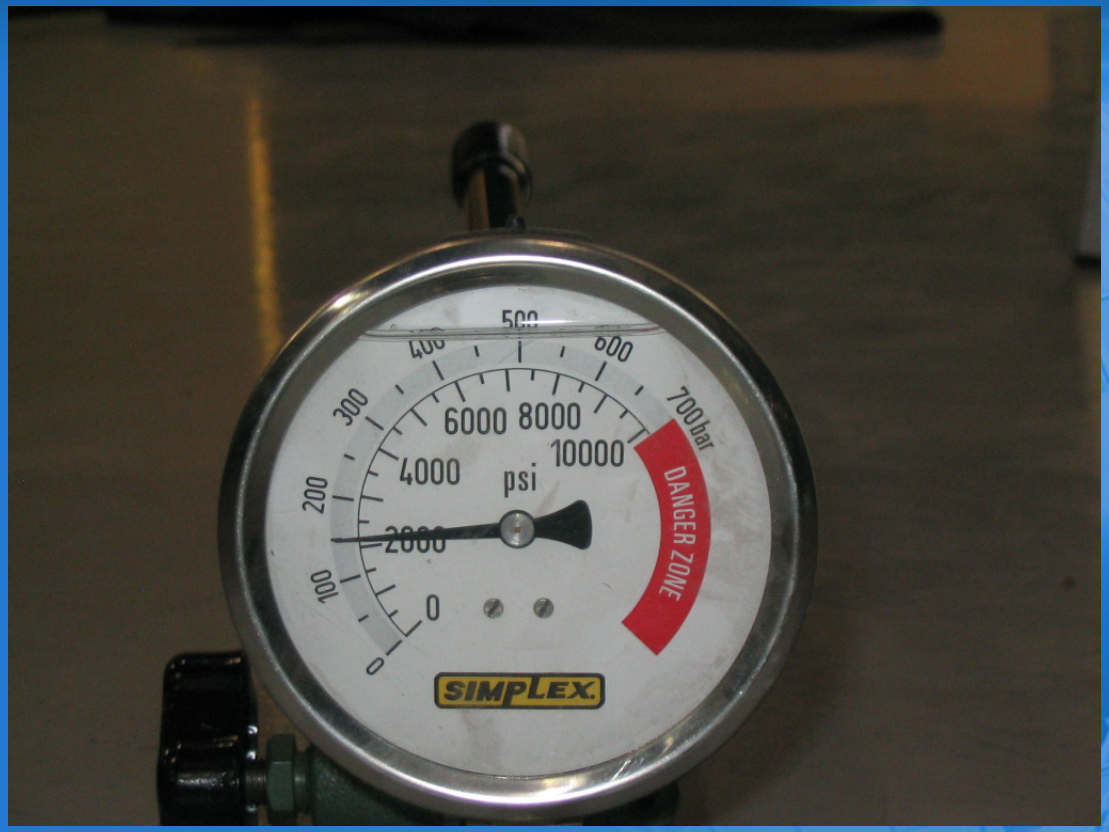
Vertical Platform Lifts
Drive Systems



- The Technicians best friend when troubleshooting hydraulic lift problems

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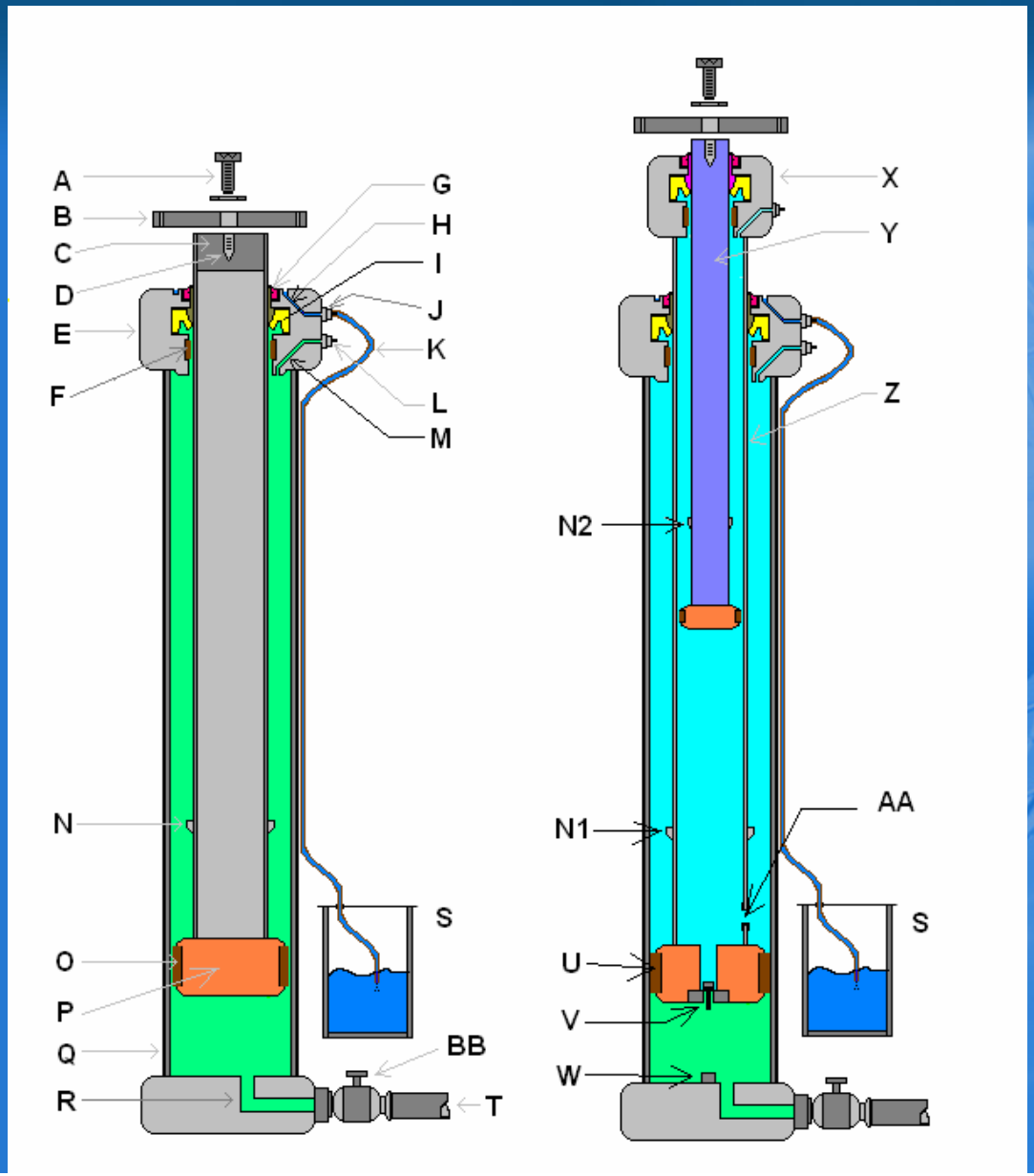

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- **Bleeding Air from a Cylinder**
- SAFETY! Work in a safe and organized manner!
- Platform can fall
- Oil can get everywhere (especially if power not off and platform is in anti-creep zone!)
- For first fill up-open air bleeder on side of jack head. Just a couple of turns
- This is a two person job with good communications (FRS radio)
- Turn on the power and start the motor using the control buttons or temp buttons. Start “jogging” the motor on-off.
- As the oil enters the cylinder , air can be heard coming from the cylinder air bleed. (Hissing)
- STOP jogging. When hissing subsides, gently jog the motor again for a few seconds until hissing starts and then stop again.

A DIFFERENT SAFETY TEST METHOD FOR SLACK ROPE SAFETIES!

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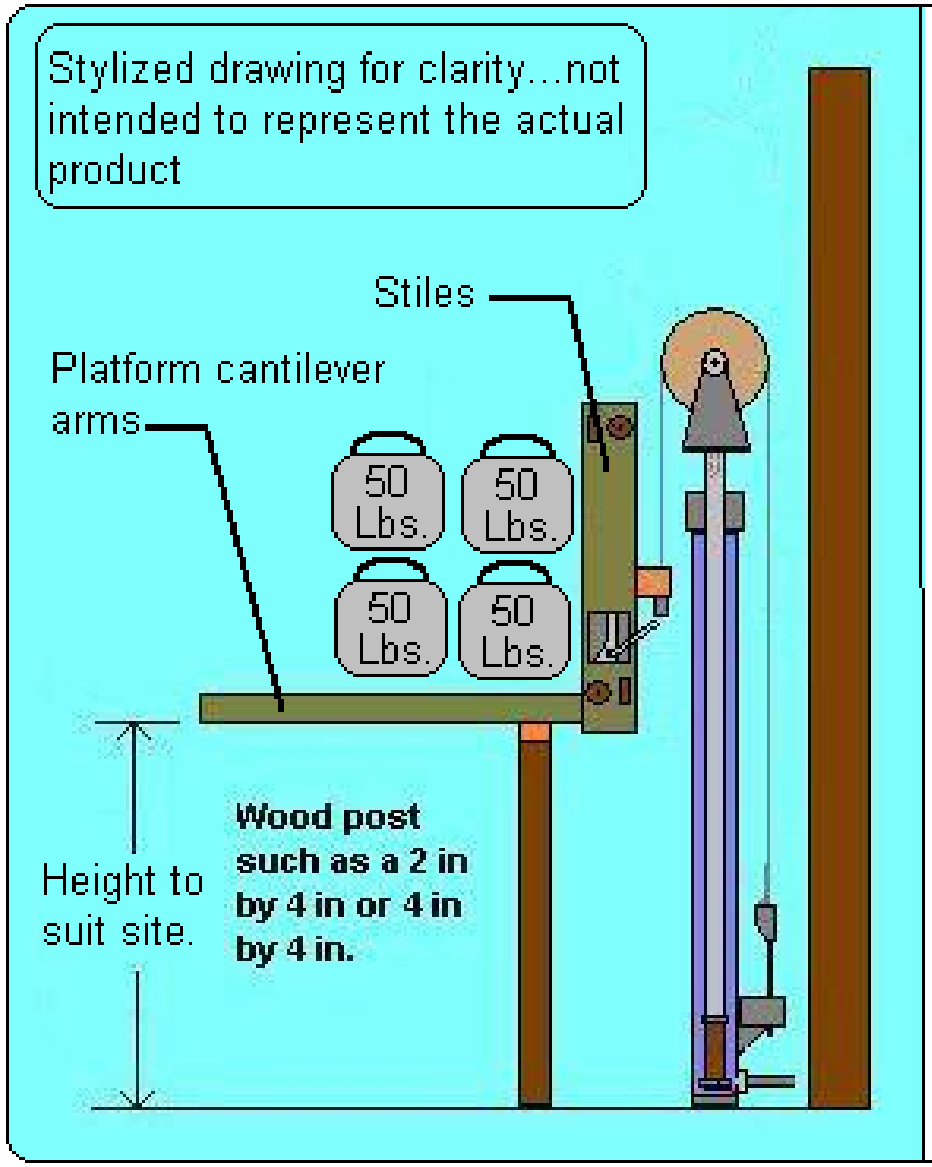
Drive Systems



Ensure the support post is placed under a stable support in the center between the two long cantilever arms. This assures strength and stability for the satety test.
Place the rated load on the platform and stack the weights so that they are evenly spaced along the control wall side.

Method 1 for carrying out a test of the platform safeties

"Knocking out a support post"

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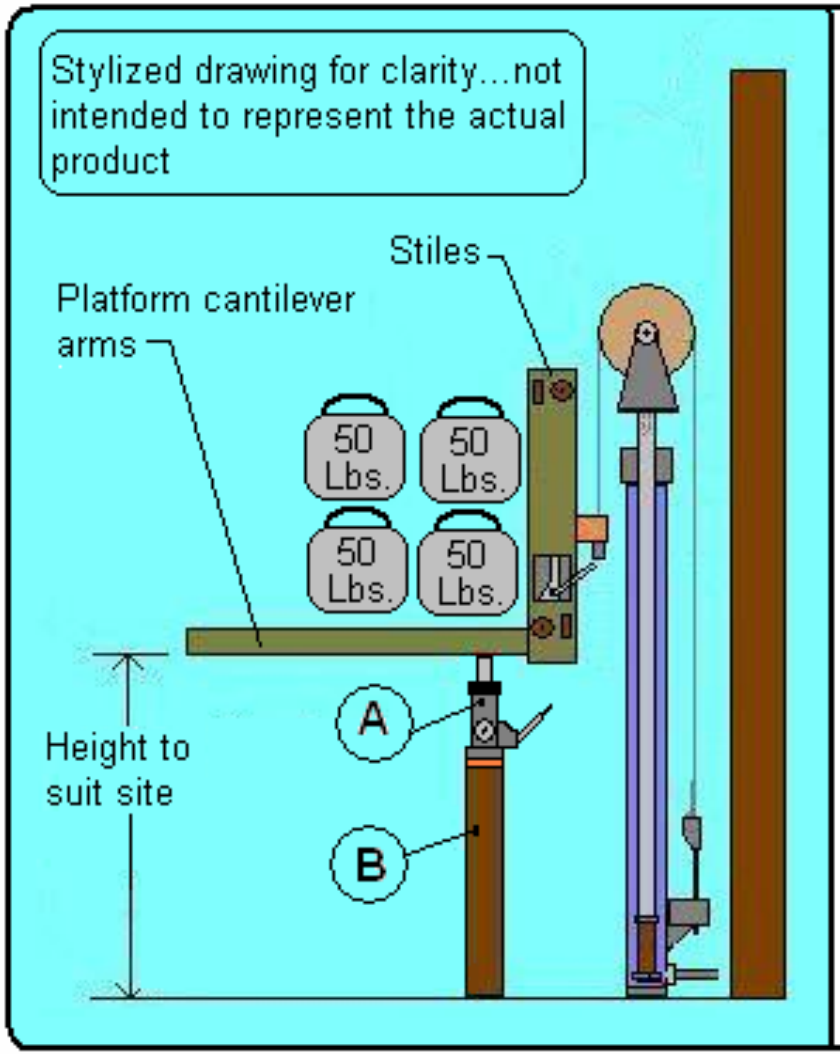
Drive Systems



Ensure the support post and jack are placed under a stable support in the center between the two long cantilever arms.
Place the rated load on the platform and stack the weights so that they are evenly spaced along the control wall.

A

Hydraulic pump-up type bottle or car jack with side pressure release valve.

B

Support post for bottle or car jack. Height to suit site.

Method 2 for carrying out a test of the platform safeties

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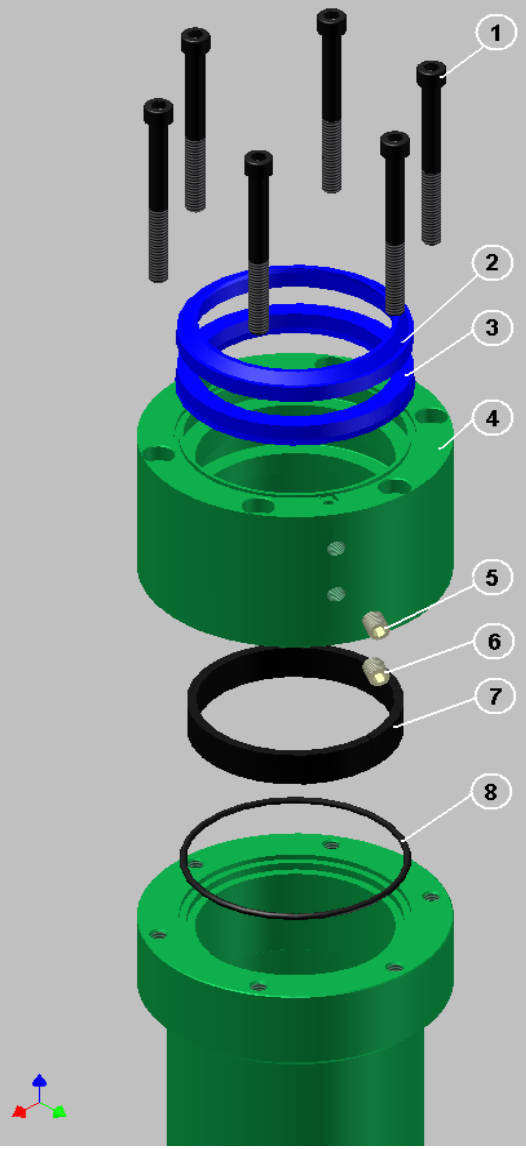
Vertical Platform Lifts
Drive Systems



CONQUEST HYDRAULIC JACK UNIT

Replacement Parts

Item		Quantity
1	1/4-20 x 2 3/4 in. Socket Head bolts	6
2	Wiper Seal (ring)	1
3	U-cup seal	1
4	Seal head assembly	1
5	Oil Recuperator fitting	1
6	Cylinder air bleeder fitting	1
7	Wear ring guide/bearing	1
8	O-ring seal	1

CAUTION
After removing the head assembly and prior to removing the old seal and wiper, familiarize yourself with their orientation within the head.

IT IS POSSIBLE TO INSTALL THE U-CUP AND WIPER SEAL UPSIDE DOWN!!

Check this drawing plus the drawing in Chapter 11 if unsure.

NOTE
Most replacement parts are sized to the jack unit model. Ensure that you order the seal kit for the correct jack size.

Jack Cylinders
Model
CQ175 = 2 in. ID and 2 1/2 in. OD
CQ250 = 2 3/4 in. ID and 3 1/4 in. OD
CQ 275 = 3 in. ID and 3 1/2 in. OD

Jacks
Models
CQ175 = 1 3/4in. Dia (VAL Only)
CQ250 = 2 1/2 in. Dia. (Wedgewood and Titan)
CQ275 = 2 3/4 in. Dia. (Phoenix LULA)

Figure 10-1

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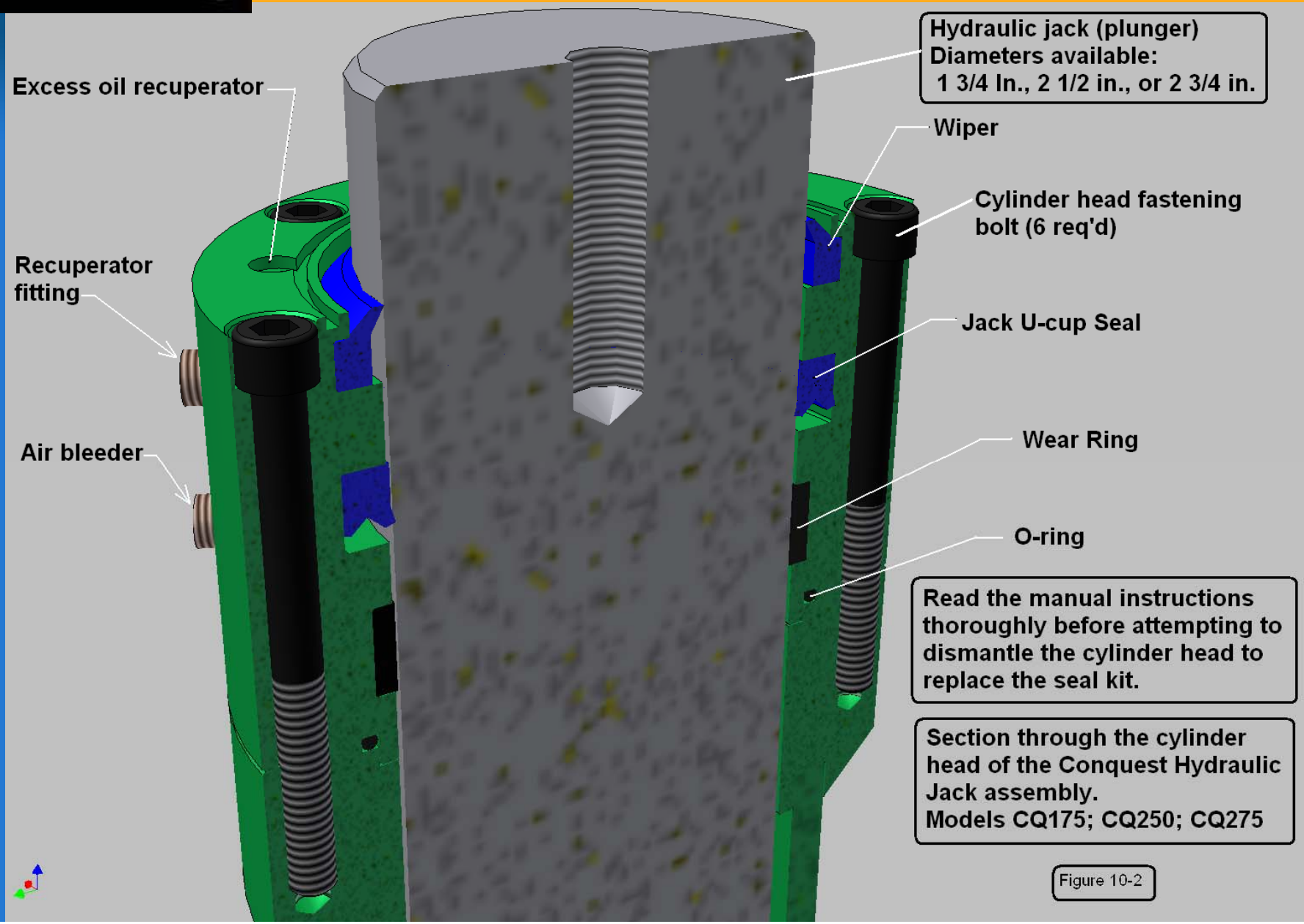
Vertical Platform Lifts
Drive Systems



Read the manual instructions thoroughly before attempting to dismantle the cylinder head to replace the seal kit.

Section through the cylinder head of the Conquest Hydraulic Jack assembly.
Models CQ175; CQ250; CQ275

Figure 10-2

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Vertical Platform Lifts
Drive Systems

- **Replacing Seals**
- Safety is of utmost importance, Only two techs should perform this work unless the lift is very short travel!
- Plan the job correctly: correct seals for the jack; all the tools; Instruction manual; rags and cleaning materials; cover sheets for customers carpets and flooring; extra oil of the correct type. Only new oil…never re-use old oil.
- Read the manual and understand the particular device…this jack may be different from others you have done. The manual will offer full instructions and safety precautions.
- Ladders and scaffolding as the job requires. Barricades if applicable plus PPE.
- Always replace all the seals and wear rings and O-rings in a jack!
- The lift must be bottomed out or properly supported with no pressure in the system
- Access the head of the jack and open the air bleeder as well

- **Replacing Seals**
- Different manufacturers will have different design.
- They will all have a U-cup type seal; a wear ring or two; a wiper ring; and perhaps an O-ring or two.
- Replace them all.
- Study manual drawings and remove the head if design permits.
- Wiper ring and seal can be removed with a small screwdriver or special tool from the manufacturer
- Wear ring may require a little coaxing as it does not bend as easily, O-rings come out easily. Compare the old ones to your replacements!

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Vertical Platform Lifts
Drive Systems

- **Replacing Seals**
- When replacing components, usually the wear ring goes in first
- The install the U-cup seal (the Main one!) This can sometimes be a little tricky and it has been found that twisting it into a figure 8 allows it to fit down inside the head. When it is adjacent to the slot for the seal, it can be released and it will snap back into its round shape. It can then be coaxed into its correct position in the seal slot. Refer to drawings!
- Warning: IT IS POSSIBLE IN SOME CASES THAT THE SEAL CAN BE INSTALLED UPSIDE DOWN! Check the configuration and the drawings and especially check the configuration when you take it out! It is a big messy job if it has to be replaced again after the whole repair is finished and the elevator turned on. That's when you will find out the seal is incorrectly installed…when oil sprays all over you and your helper and customer and his home! Start again!
- Replace the wiper ring…it usually goes in quite easily. The wiper ring does no sealing…it is simply a guard that wipes off any dirt on the surface of the jack before it can enter into the cylinder.
- Fitting the head (if applicable) over the end of the jack can be a little tricky as well. It depends on the quality of the mfr. If the end of the jack has been chamfered on the exterior diameter, then the head and seal will nicely slide over it. It doesn't hurt to put a little white lithium grease on the seal and inside the head to assist replacement.

- **Replacing Seals**
- When the head fits over the end of the jack, there is usually an O-ring where it fits against the top of the cylinder to assist in sealing.
- Ensure the O-ring is installed.
- Tighten the bolts as applicable to the torque level stated in the manual. Wipe everything down.
- If care was taken, it may not be necessary to add oil as little escaped. However, if necessary add oil and follow the air bleed procedures.
- Re-install the scavenger line if it was originally installed. (This brings any excess oil from the head to the storage tin in the pit if there are any leaks)

- **Replacing Seals**
- Re-check the area and remove tools, cleaning materials etc and prepare to start the lift to check your work.
- Ensure the air bleed is closed; there are no parts left at the head; no tools are in the way of the movement of the lift. Your co-worker is in a safe place and the power is turned on.
- With no load in the car…run it up and down and check for leaks and smooth operation.
- When finished CLEAN UP the area and remove all debris and tools and ensure that your oily shoes or boots have not made a mess of the carpets or floors.
- Do a load test before leaving the area.

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Vertical Platform Lifts
Drive Systems

- NOTE: It is possible that different seals may be used to those mentioned.
- In some cases, ”V” groove type packing is still used by some mfrs.
- These usually take the form of a short stack of 3 or 4 “V” shaped seals that embed together and are simply inserted in the available area in the head.
- They are usually easier to install than U-Cup seals.
- In some rare cases, jack seals are simply O-rings that are replaceable. O-ring seals are usually the sign of a low quality mfr and should be avoided…they usually have a short, leaky life!!

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Vertical Platform Lifts
Drive Systems

•PLUMB AND SQUARE MAST

• Typical platform lifts with the equipment mast have one unforgiving condition that the tech must pay attention to during installation.

•That is getting the mast plumb and square!

•This seems easy but is sometimes missed and can cause big problems!

•The problem is when the tech assumes the wall is plumb and square

•Remember that with screw drives the motor runs for UP and DOWN and thus can sometimes PUSH the carriage through a tight spot in the rails.

•Not so with a hydraulic…especially empty.

•The platform comes down of its own weight and if there any tight spots the platform will just “jam” in the shaft.

•In the UP direction the motor will push the platform through a tight spot but not in the DOWN direction.

•It is extremely important to properly plumb and square off a hydraulic installation for this reason.

•Disney World!

AEMA Continuing Education
Vertical Platform Lifts
Drive Systems

- **MANUAL LOWERING**
- Every lift is provided with a means to lower the platform in an emergency
- Hydraulic is easier than screw drive
- On unit valves the manual lowering is clearly marked knob or handle
- One some the handle gets turned and stays turned and the lift lowers until the handle is rotated back to center
- On others it is spring loaded and returns to OFF when released.
- ALWAYS INFORM THE PERSON ON THE PLATFORM OF YOUR INTENTIONS BEFORE MOVING THE PLATFORM.
- Never move a lift on manual without turning off the main power and the auxiliary power if provided.
- Alert and instruct the owner of the dangers of using the manual lowering for other than emergency purposes. ALL SAFETY SYSTEMS ARE BYPASSED!
- Manual lowering on a typical mast style VPL must be accessible from outside the platform….it is not permissible to enter under the platform or operate the manual lowering from inside the platform.

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Drive Systems

Blain KV1P valve with Manual Lowering

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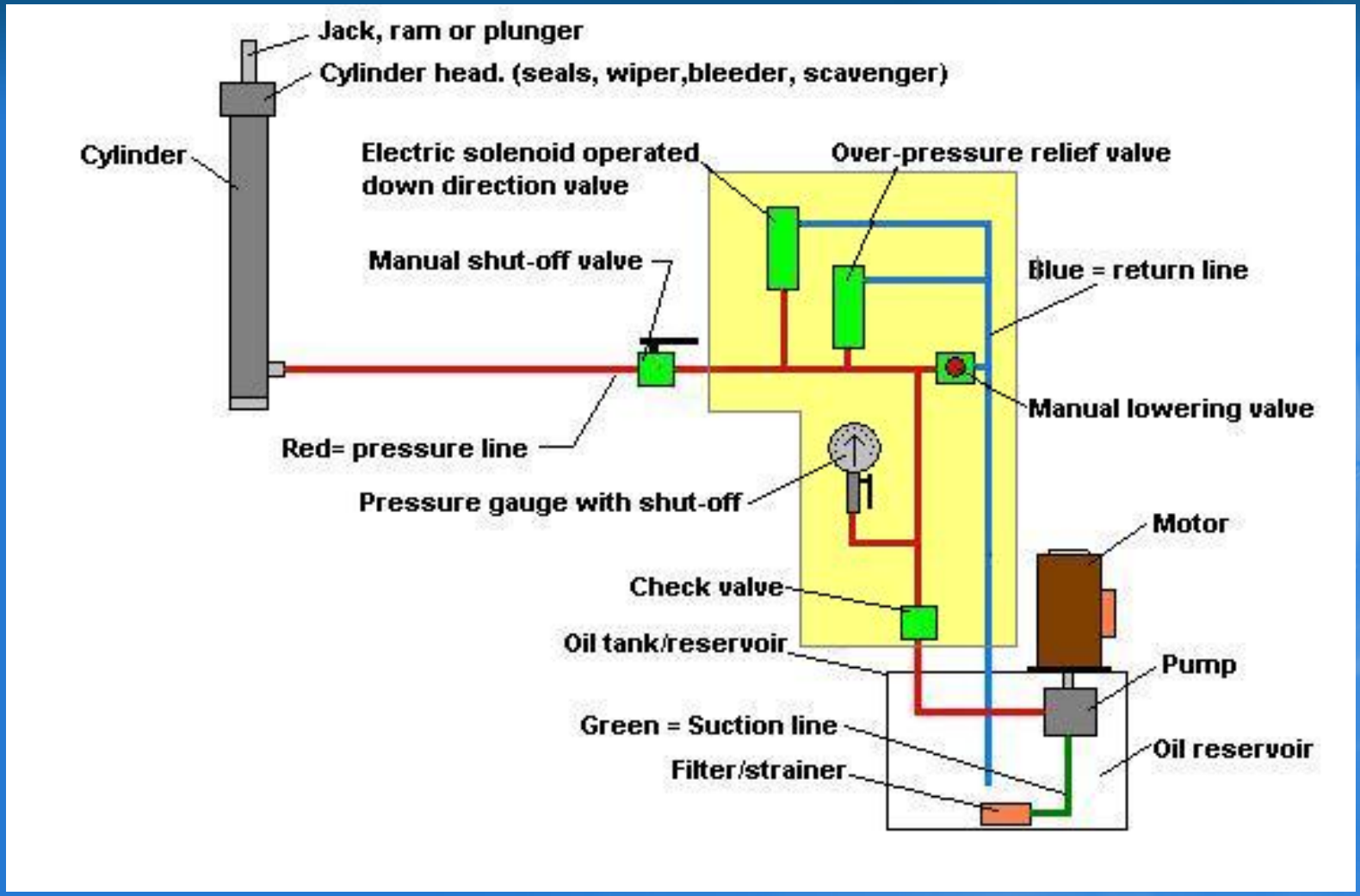
Drive Systems



Stylized hydraulic system for A Vertical Platform Lift

•WHAT DID WE LEARN TODAY

- •Components of a typical roped hydraulic lift system
- •The three types of pumps and their advantages and disadvantages
- •How the speed of a lift is ascertained
- •The rationale for using Roped or chain hydraulic compared to direct.
- •Why plumb and square is so important for a hydraulic drive VPL
- •How the mechanical advantage of 1:2 hydraulic drive actually works
- •How to replace jack seals and the different types in normal use
- •Safely bleed the air from a hydraulic cylinder
- •Working, relief and negative pressure defined
- •How to calculate for and set the relief valve

•WHAT DID WE LEARN TODAY

- •The definition and operation of a displacement style hydraulic jack
- •Other jack types
- •Definition and difference between a PISTON and a PLUNGER or RAM or JACK
- •The purpose of the multiplier sheave
- •Setting the negative pressure switch
- •Safety and the manual lowering valve
- •Hydraulic schematic for a simple lift system
- •The components, operation and replacement of the hydraulic jack sealing system
- •A different method of performing a slack rope safety test

AEMA Continuing Education
LULA Elevators
Information

"LULA"

AEMA

AEMA Continuing Education
LULA Elevators
Information

We will discuss:

- The concept
- The publication
- What's a "LULA"
- The Differences between a FPE and LULA
- "Safety"
- Are all LULAs the same?
- Review
- Q & A

The Concept

The Concept: a little history!

- Private residence elevators used for Accessibility to meet ADA
- restart of 1977 low rise elevator committee
- a joint committee established of Private Residence elevator mfrs and Elevator mfrs
- joint committee started on two tracks: is this new “LULA” to be an upgraded Private Residence Elevator (PRE) or a modified Full Passenger Elevator! (FPE)

The Concept:

- The PRE mfr's started with the old Part V of the A17.1.
- The FPE mfrs started with Parts 2, 3
- eventually, a modified FPE concept was instituted
- should it be restricted access or unrestricted access?
- First name was Limited Use-Limited Access Elevator, changed to Limited Application when unrestricted use recommended.
- The first definition:

The Concept:

*Limited Use/Limited **Access** Elevator:*

*A power passenger elevator in which the use and application is limited by size, capacity, speed and rise . **intended principally for use by disabled persons.***

This definition was changed to:

The Concept:

Limited Use/Limited Application Elevator:

A power passenger elevator in which the use and application is limited by size, capacity, speed and rise.

The reason:

The Publication

The Publication:

- The LULA section of the A17.1 was originally designated to be Part XXV of the old A17.1 Standard (Now Section 5.2 of the harmonized version)
- It was first published in the 1995b addenda of the A17.1
- Currently, the new 2007 “harmonized version” of the A17.1/B44 has been published and is applicable to the USA and Canada.

This term is an acronym for:

LIMITED USE, LIMITED APPLICATION ELEVATOR

What's a "LULA"?

A typical LULA can closely resemble a Full Passenger Elevator (FPE)

- **OK… but what does it mean really!**
- **LIMITED USE**….Means that it's intended to be used in low rise buildings with low occupancy.

- **LIMITED APPLICATION**… Means that it's application in buildings will be "self limiting" due to the low travel, speed, capacity and size

Full Passenger Elevator

1. **Unlimited Use**
2. **Unlimited Application**

ADA

- ADAAG states that a LULA is permitted
- Entrances only on the narrow ends
- Side entrances not permitted
- A square cab 51” by 51” can have entrances adjacent.
- Minimum platform size is 36” by 60” in existing buildings

Full Passenger Elevator

1. **Side entrances permitted due to platform sizes**

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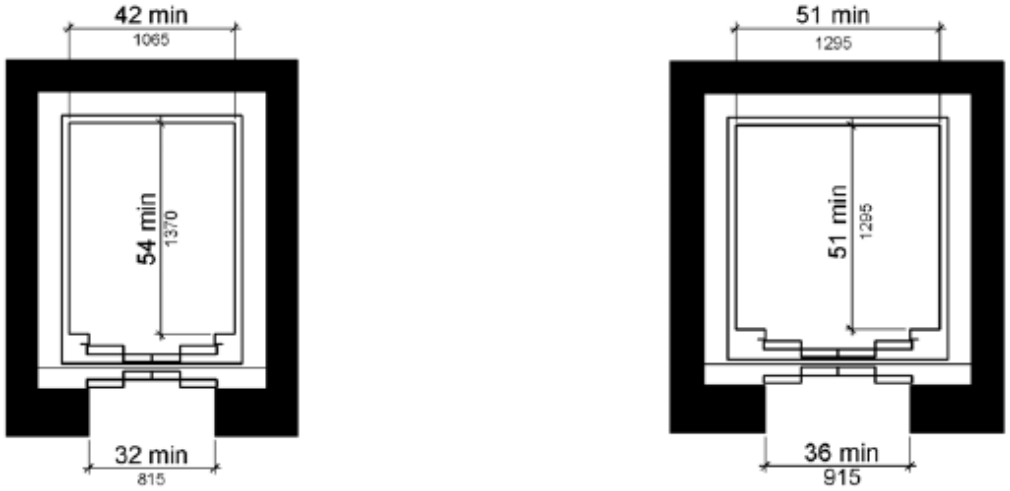
LULA Elevators



408.4.1 Car Dimensions and Doors. Elevator cars shall provide a clear width 42 inches (1065 mm) minimum and a clear depth 54 inches (1370 mm) minimum. Car doors shall be positioned at the narrow ends of cars and shall provide 32 inches (815 mm) minimum clear width.

EXCEPTIONS:

1. Cars that provide a clear width 51 inches (1295 mm) minimum shall be permitted to provide a clear depth 51 inches (1295 mm) minimum provided that car doors provide a clear opening 36 inches (915 mm) wide minimum.

2. Existing elevator cars shall be permitted to provide a clear width 36 inches (915 mm) minimum, clear depth 54 inches (1370 mm) minimum, and a net clear platform area 15 square feet (1.4 m2) minimum.

What's "LIMITED" about a LULA?

FPE
Unlimited

- Max travel 25'-0"(7,6m)
- Rule 2501.8e or Requirement 5.2.1.16.5

Unlimited

- Max speed 30 FPM (0,15m/s)

Rule 2501.8d or Requirement 5.2.1.16.4

Unlimited

- Max Platform size 18 ft/^{2},(1,67 m/^{2})
- Rule 2501.8a(2) or Req. 5.2.1.16.1(b)

Unlimited

- Max capacity 1400 lbs,(635 kg)
- Rule 2501.8a(1) or req. 5.2.1.16.1(a)
- Where did these originate…….?

What's "LIMITED" about a LULA?

- Basically, the dimensions and capacity were taken from the European EN81 sizes for a 630 kg (9 person) lift. (1386lbs….rounded to 1400 lbs for a LULA)

INTENDED LOCATIONS!

- Buildings where an FPE is not required; this may be subjective.
- Non accessible routes in buildings
- Ideal for: what type of buildings?
- Churches; Schools; Legion Halls; Doctor’s offices; municipal buildings; etc.
- Ideal for existing building retrofits
- Not necessarily a replacement for a FPE!!

A Common Misconception

- Misapplication can be a problem
- A slow LULA in a busy environment can create usage and operational problems.
- Not “An upgraded Wheelchair Lift”!
- It is a “modified FPE”
- Environment around the elevator is modified not the elevator!

The Differences

What's modified!

FPE Requires min 42" top of car refuge space And Minimum 24" Under car refuge space Extensive rules for machine area

- Reduced bottom car clearances

  Rule 2500.8 or Req. 5.2.1.4.1

- Reduced top of car clearance (refuge)

  Rule 2500.8c or Req. 5.2.1.4.4

- Machinery Space

  Rule 2500.2 or Req. 5.2.1.7

Drive can be adjacent; in a machine room; in a shared room or in the hoistway!

LETS WATCH A VIDEO

How do we provide protection for a tech
If there is insufficient overhead refuge
Or insufficient refuge space in the pit?

What's modified!

- Rope to sheave ratio 30:1 or 21:1 depending on rope used.
- Regular elevator rope 30:1

  Rule 2501.9(b) or Req. 5.2.1.20.1(a)
- Aircraft cable rope: 21:1

What's modified!

- Cannot be used in drive applications where the aircraft cable rope will be subject to "crushing" applications!
- Such as……?

What's modified!

- ……Traction Drive!
- OR……?

What's modified!

- ……multiple layer drum drive!

What's modified!

FPE
Aircraft cable
not permitted

- Aircraft cable rope is to be manufactured to MILSPEC 83420 with some exceptions.
- Typically it is identified as a commercial version of the MILSPEC 83420
- Breaking strength is quite high

  14,400lbs (6545 kg) for 3.8" (9,5mm)

What's modified!

- Governor can be 30 times rope to sheave ratio
- governor rope can be min. 1/4" (6mm) diameter.

  Rule 2501.7(c) or Req. 5.2.1.18(c)
- Governor access panels not always required:

(self-resetting governor)

What's modified!

FPE Bumpers OK If speed restricted To 50fpm or less for hydraulic

- Buffers and bumpers……bumpers can be used and elastomeric bumpers permitted!

  Rule 2501.2 or Req. 5.2.1.22

- Guide rails can be non-traditional:

  Common rails permitted plus other shapes and types

  Rule 2501 or Req. 5.2.1.23

- single wrap drum type machines permitted without counterweight

  Req. 5.2.1.24.1

What's modified!

- Fire Service not required but if provided voluntarily, then it must meet all requirements of the standard. (Phase 1 and Phase 2)

  Rule 2501.12(b) or Req. 5.2.1.27

Change coming to 2008 addenda where only phase 1 Fire Service will be required.

What's modified!

FPE
requires 3" at the
Bottom runby for
equivalent speed

Car doors are
restricted to type if
ADAAG applicable

- Reduced runbys (hydraulic):

  min 3" (75mm) at the top floor and

  min 2" (50mm) at the bottom floor.

- Car doors can be horizontal sliding; accordian or bifold….manual or power operated.
- But….for accessibility???

Safety!

What's not modified!

- The safety level of the equipment
  Equivalent safety provided as detailed in section 1.2 of the standard.
- If hydraulic, which most are, then most of Section 3 (The hydraulic section of A17.1 and B44) applies
- Typically it is the environment around the elevator that is modified not the elevator or its equipment!

Are all LULA's the same?

Are all LULA's the same?

- Accessible route makes the difference!
- Is A117 applicable ?
- Does the building code require an accessible elevator in this location?

- If not…….

Are all LULA's the same?

- ……..then a LULA can look a lot like an enclosed vertical platform lift from the CSA B355 or even a Private Residence Elevator
- Manual Swing doors permitted
- Constant Pressure operation permitted
- smaller platforms are permitted
- accordian, bifold or horizontal sliding car doors

Are all LULA's the same?

- IF ON AN ACCESSIBLE ROUTE: we must provide equipment as required by ADAAG.

Are all LULA's the same?

SUMMARY

- 1. There are two LULAs…one for use in Accessible routes and one for other uses
- 2. All comments reference National codes, the AHJ may want something different in their LULA!

Are all LULA's the same?

REMEMBER:

- A "LULA" is just an FPE with an alternative way of offering the same level of safety to the public; the mechanic and the inspector!

Review

Review

This afternoon we talked about:

- Concept

  where did the idea of the LULA come from and how did it develop?

  How is it defined?

Review

This afternoon we talked about:

- What's a LULA?

  Appearance

  Limitations: max travel? Max capacity? Max speed? Max size?

  Application

  where is it referenced in other codes?

  Where does it fit in Canada currently?

  Where did the sizes come from?

  Intended locations

Review

This afternoon we talked about:

- The Differences

  reviewed and compared the main differences between a LULA and an FPE

  environment around the elevator

  reduced bottom and top clearances

  machinery space differentials

  aircraft cable rope

  Fire service (is it required by the LULA code?)

  plus……...

Review

This afternoon we talked about:

- The Differences

  Buffers and bumpers

  guide rails

  Car doors

  governors

  access panels

and most important……..

Review

This afternoon we talked about:

- Safety

  No compromise on the level of safety as compared with an FPE

  Alternative methods used to ensure an equivalent level of safety

Review

This afternoon we talked about:

- Are all LULAs the same?

  Two types of LULAs

  one for accessibility and one for other applications

Any questions?

THANK YOU!