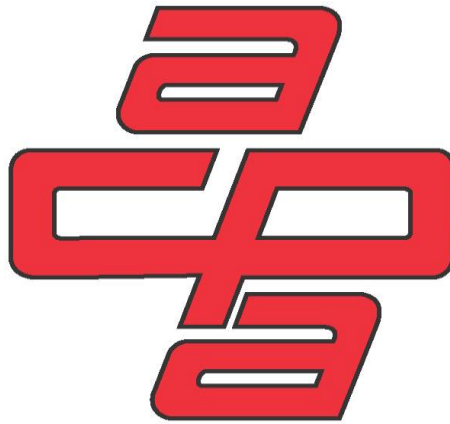


AMERICAN CONCRETE PUMPING ASSOCIATION



CERTIFIED OPERATOR STUDY GUIDE

Guidelines for the safe operation of concrete pumps

Version 03.11.01

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Monday through Friday**

**American Concrete Pumping Association
Certification Program
for
Concrete Pump Operators**

OBJECTIVES

- To raise the professional standards of the concrete pumping industry in general, and of concrete pump operators, in particular
- To improve the safety awareness and practice of concrete pump operators
- To encourage continuing education of concrete pump operators
- To assist in an operator's development and self-improvement
- To award recognition to concrete pump operators who meet the qualifications of certification

INDEX

Page

4	WHAT IS CERTIFICATION?
4	QUALIFICATIONS
5	TESTING PROCESS
6	VALIDATION
6	SECURITY/COST
7	GENERAL SAFETY - What is a concrete pump operator expected to know?
10	TECHNICAL
13	GROUT & PEA ROCK PUMPS
16	LINE PUMPS - General & High Pressure - ACPA recommendations - High-rise pumping - Compressed air cleanout
21	MULTIPLE SECTION BOOM PUMPS - Safety regulations – mobile concrete pumps equipped with placing boom - Three-Section Boom - Four-Section Boom - 50-Meter and Larger
32	SEPARATE PLACING BOOMS - All placing booms - Diesel-driven placing booms - Electrically driven placing booms - Completion of the pour
36	SAFETY HAND SIGNALS

WHAT IS CERTIFICATION?

Most importantly, what does certification mean?

ACPA Certification is the only industry-recognized certification program which provides a written assessment of an operator's knowledge regarding concrete pump safety.

The purpose of certification is to increase the safety awareness of concrete pump operators and to assist in an operator's development and self-improvement. Certification thus permits concrete pump operators to raise the professional standards of the industry by maintaining and improving safe operation of concrete pumps.

Certification applies to individuals and is granted by the American Concrete Pumping Association to persons who have met the pre-determined qualifications established by the ACPA Certification Committee. This is a voluntary program and is open to any concrete pumper, whether or not his employer is a member of the American Concrete Pumping Association.

QUALIFICATIONS

The operator must possess a valid driver's license or equivalent in the operator's country of employment and have specified experience with the particular equipment for which the operator would be certified. It also requires the operator to pass an examination that tests knowledge of the equipment and its safe operation.

Successful operators receive a wallet-size certification card that designates them as an ACPA CERTIFIED CONCRETE PUMP OPERATOR.

Operators who do not have the required experience are encouraged to take the written test and will receive a 'safety card' that will be effective until they do have the required time.

TESTING PROCESS

All operators must fulfill the required amount of safety training education as a prerequisite for ACPA Certification. This requirement may be obtained in one of two ways: a) attend an ACPA Operator Safety Seminar or, b) view the ACPA Operator Safety Presentation, take the corresponding quizzes and have the operator's supervisor attest to the completion. This requirement also applies to current ACPA Certified Operators when their certification expires for the first time. Should an operator need help with verification of the safety training education, the ACPA maintains records of attendance at ACPA Operator Safety Seminars and maintains a list of operators who have completed the 23-Day Operator Training program. The Association can also verify an operator's training requirement within the past two years upon request. Once the operator has recertified under these requirements, proof of eligibility will not need to be provided. Each individual concrete pump operator must fill out an application on the inside cover of the certification test. Once the application is properly filled out, he must have his employer, or supervisor, complete the work experience portion of the application and sign his/her name on the designated line. The test is then administered by an authorized ACPA representative or by the supervisor/employer and witnessed by a designated person of the company. After the test process, the test is then sent to the ACPA National Office for processing.

The test is computer graded at the National Office and the test results are mailed back to the operator's place of employment. If the operator fails any section of the test, they have 60 days to retake that section of the test and return the test to be re-graded. If the corrected test is not returned within 60 days, the test is voided and the operator must retake the entire test. A failed test section may be retaken a maximum of two times. After the failed second attempt, the operator must retake the entire certification test.

Upon receiving a passing grade, the operator will receive a wallet-size "ACPA Certification Card" and an "ACPA Certified Operator" clothing patch, as well as a hard hat certification decal.

The Certification Committee of the ACPA will control the contents of the testing materials to insure that the program is kept current with industry trends.

VALIDATION

Certification is valid for two years. After two years, the operator must take the ACPA Re-Certification Exam to renew certification. If the operator fails to take the re-certification test before the last day of the month when his certification expires, he must take the certification test again. The National Office will send a renewal notice to the operator's employer of record advising him/her of the upcoming expiration. Ultimately, it is the responsibility of the operator to renew their certification and to know when his/her certification is due to expire and to schedule their re-certification test.

SECURITY

Certification and Re-Certification tests are the property of the ACPA and will be held at the ACPA National Office for a period of three years; however, a permanent file is kept on each operator who takes the certification test and test results, along with any other operator information, and will be released only to the operator or his/her current employer.

WHAT DOES CERTIFICATION COST?

The cost of certification for ACPA members is \$60. For a non-member the cost is \$225.

The cost of re-certification for ACPA members is \$35. For a non-member the cost is \$150.

This program is meant to encourage safe driving as well as safe operation of a concrete pump. None of the above should supersede the employer's regulations and/or requirements, or the local, state, provincial or national laws.

GENERAL SAFETY

Safety is a major concern of every person involved in the concrete pumping industry. It is vital to everyone involved with concrete pumping, from the concrete pump operator, to the ready mix driver, to the man on the end of the hose and to the construction contractor, that at all times they all **must make safety a top priority**. By working together as a team and following rules for safe concrete pumping, accidents can be substantially reduced.

With design variations of the many different concrete pumps, it is not possible in this book to specify all the safeguards that should be incorporated in the construction and operation of concrete pumping equipment. The manufacturer of the equipment being operated should be contacted for specific operating instructions. The information contained herein does not supersede the manufacturer's operating instructions or local laws and regulations.

Although the American Concrete Pumping Association does its best to ensure that any advice, recommendation or information it may give is accurate, no liability or responsibility of any kind (including liability for negligence) is accepted in this respect by the American Concrete Pumping Association or any of its affiliated chapters or any of its servants or agents.

WHAT IS A CONCRETE PUMP OPERATOR EXPECTED TO KNOW?

The main purpose of this program is to encourage pump operators to be safety conscious and adhere to safety procedures. Safety rules won't help you unless you know and use them. Remember that safety isn't just an idea on paper,

SAFETY IS THE MOST IMPORTANT PART OF YOUR JOB

Safe operation and familiarization of concrete pumps and booms is most important before any person is to operate a concrete pump without supervision.

BE ON TIME AND BE PREPARED TO WORK. This is very important to safety, as being late may cause an operator to hurry or take shortcuts in safety procedures. The safe operation is then extended to: the pre-job inspection of the concrete pump before leaving the yard; driving to the job site safely; setting up and safely operating the concrete pump on the job site; cleanup and driving back to the yard or on to the next pumping job. The last part of a safe operation is checking and cleaning the pump to prepare for the next safe pour. Whether you operate a grout pump with 150 feet of placing line, a three-, four-, or five-section boom pump or a trailer pump with a placing boom, your safety and the safety of other personnel involved with the concrete operation should be your main concern. A worn-out cliché "The life you save may be your own" is certainly true as a concrete pump operator.

Before entering any work area, an operator should have the following personal safety equipment:

- Hard hat
- Snug-fitting work clothes
- Safety goggles or safety glasses
- Heavy-duty work shoes or boots and gloves
- Rubber boots and gloves (for cleanout)
- Breathing mask (if exposed to cement dust)

Check for other special personal protective equipment which may be required such as: long-sleeved shirt, hearing protection, steel-toe boots and rubber gloves. It is important that an operator have all necessary work tools relating to the job and pump being worked on.

Check engine oil, hydraulic oil and radiator water, and yell **"CLEAR"** before starting engine. Inspect all safety covers, instruments, gauges, grates, tires, outriggers, etc. for safety and proper operation. A D.O.T. pre-check inspection must be performed on all trucks equipped with air brakes.

A pump operator should verify proper cleanout equipment is available and also verify proper number of safety slings, cables or chains is available for any system which can fall or drop. All clamps, if so designed, should be pinned at all times, including boom system. **A general rule is: one safety sling for every item hanging from the boom, because a sling must be installed between each suspended piece of system.** The anchor point for a safety sling should be the boom itself, not pipeline. **Before operating any piece of concrete pumping equipment, the operator should read and understand the manufacturer's operating manual.** Contact the manufacturer if not completely

understood.

It is important for a pump operator to know who will be giving the directions for the movement of the boom. Therefore, you must determine who this person is. **ONLY ONE PERSON is to give directions to the pump operator.** There are fourteen (14) safety hand signals - every concrete pump operator should know them.

The ACPA endorses a drug-free and alcohol-free work place. It is the responsibility of the employees to adhere to the employer's substance abuse program. Remember: DRUGS AND CONCRETE DO NOT MIX.

The ACPA has adopted the position that if electrical wires are within 20 feet of the area to be poured, (50 feet when the voltage exceeds 350kv) a dedicated spotter will be employed whose only job is to monitor the movement of the boom and warn the operator if the boom approaches closer than 20 FEET (50 feet when the voltage exceeds 350kv) to the wires. This rule does not supersede any local, state/provincial or national law requirements.

It is important that the pump operator **WORK IN A CLEAN WORK AREA AND KEEP IT CLEAN.**

TO PREVENT SERIOUS INJURY, NEVER REACH INTO THE VALVE OR THE WATER BOX. The water box covers must be in place when the machine is in operation. When removed, the transmission must be out of gear and the accumulator bled to zero pressure.

The above are general safety rules for all concrete pumps and should be strictly followed. Concrete pump operators are special people. An operator needs to be a good driver; needs to be mechanically inclined; needs to understand the operations of his pump; needs to be a public relations person on the job by projecting the right image for his company; but most importantly, must be current on safety and have good safety judgment in the operation of a concrete pump. What this all points out is the concrete pump operator strives to be a professional.

Remember the most common cause of fatal accidents involving concrete pumps is electrocution.

TECHNICAL

When pumping, the maximum size of the coarse aggregate is limited to one-third of the smallest inside diameter of the pump or placing line. For example, 1-1/2 inch aggregate would require a minimum placing line diameter of 4-1/2 inches.

The properties of the fine aggregate or sand are more important in the proportioning of pumpable mixes than are those of the coarse aggregate. If the sand is overly coarse, it will make a normally pumpable mix design difficult to pump while fine sand will make coarse mixes pumpable.

The fineness modulus of sand meeting ASTM C 33 gradation specifications will fall between 2.30 and 3.10 with the median being 2.70. The higher the fineness modulus, the coarser the sand. Pumpability of mixtures is generally improved with a decrease in the fineness modulus, or in other words, with the use of finer sands. However, sands having a fineness modulus between 2.40 and 3.00 are generally satisfactory. Sands with a fineness modulus in excess of 3.00 are difficult to pump.

Lightweight coarse aggregate for pumping must be pre-soaked in stockpiles or bunkers prior to use. Generally a minimum of three to five days of sprinkling is recommended. It is important to turn the stock pile during soaking to insure uniform and complete saturation.

Reducers and bends in the placing line, such as elbows or hoses, create turbulence inside the line. A well-graded mix with the proper mortar (cement paste) will move easily through the pipeline, while a lean or poorly-graded mix may not. A reducer is usually the first place to look when a plug occurs. (Remember: Always relieve pressure in the placing line by pumping a few strokes in reverse before opening a coupling.)

Tests by the National Ready Mixed Concrete Association have determined that entrained air can be lost when concrete is allowed to slide down the five-inch diameter pipeline of long truck booms under its own weight. To prevent air loss when pumping, it is advisable to prevent the concrete from "free falling" by keeping the tip section level, by adding a smaller diameter discharge hose or laying a discharge hose on the deck. When testing labs take samples, the tester should get the sample from the normally placed concrete. They should not stop the pump and place a small quantity dropped from the boom into a wheel barrow. Concrete must not be allowed to free fall into the tester's container.

Both steel fiber and synthetic fiber reinforced concrete can be pumped.

Concrete mixes often contain a variety of admixtures. Any admixture that improves the workability, generally will improve the pumpability. Some of these admixtures are water-reducing admixtures. Most water-reducing admixtures will improve the pumpability of the mix as long as sufficient free water remains. High-range water reducers (super-plasticizers) increase the slump dramatically and improve the pumpability, especially on high-rise jobs, lightweight jobs or long distance pushes. However, remember super-plasticizers are only effective for a limited time. Once the time has run out, the concrete returns to the state it would have been had the super-plasticizers not been added. At that time, the slump may drop rapidly.

Another common admixture is air entrainment. Air entrainment is added to concrete to keep the concrete from breaking down and spalling during freeze/thaw cycles so it is more common in harsh-

winter regions. Air entrainment up to six percent will generally make the mix more pumpable. However, low slump mixes with high air content (above eight percent), are difficult to pump. It could be compared to trying to push a beach ball through a hole. Air-entrained mixes are generally more plastic and more workable than non-air entrained mixes and less inclined to separate or bleed.

Pumpers often want to add water to concrete to make it pump easier. Water should only be added by the contractor, or his designated representative. Excess water alters the mix design by increasing the water-cement ratio, which can lead to decreased strength and excessive shrinkage. Excess water can also cause segregation, which is the separation of the components of the concrete. Segregation can also be caused by dropping concrete which causes the lighter mortar and sand to separate from the rock.

When priming, remember to pump the primer into the valve and placing line ahead of the concrete to keep the slurry from mixing with the concrete in the hopper. This could cause you to be short of primer resulting in a plug, and it could cause a problem if the primer is discharged into the forms. Use the prime port on the machine, if available.

While modern concrete batch plants usually produce a consistent product, occasionally problems occur. It is possible that one component could be omitted or aggregate from certain areas of a stockpile could be different. Dramatic changes in pumping pressure from one load to another could signal a “problem” load. Sometimes a “problem” load can be blended with one or more loads, and therefore, not be wasted.

The pump should be located as near the placing area as is possible and concrete placing should commence at the point most distant from the pump. This allows the entire placing line to be grouted before concrete placing begins.

The valve in a concrete pump must be kept in good repair. If the valve is allowed to wear excessively, mortar may be squeezed out of the mix causing plugs. Some valves require periodic adjustments to control the loss of mortar out of the valve.

Badly worn piston heads in concrete cylinders can allow water from the water box to be admitted into the concrete, causing higher slumps and possibly separation and plugging, as well as lower concrete strengths.

It is important to monitor the temperature of your hydraulic oil while pumping. If the oil gets hot you should:

1. Stop pumping.
2. Check to see if your oil cooler is working. Some pumps have an override to turn on the cooler fan.
3. Quickly attempt to locate the heat source; such as an outrigger valve or other valve left in the wrong position.
4. Make certain the water box is full of water.
5. Spray a mist of cool water over the hydraulic system and hydraulic oil tank.
6. Slow down the pumping speed.

* If you are consistently overheating you possibly are developing a problem with the concrete pump, such as worn piston rings or a low-pressure relief valve setting. You could be running the wrong

grade of hydraulic oil. The problem should be corrected as soon as possible.

Many of the gauges are in metric or European values.

Temperature in Celsius can be converted to Fahrenheit by the formula:

$$C = (F - 32) / 1.8$$

or

$$F = (C \times 1.8) + 32$$

Take the Celsius reading, multiply by 1.8 and add 32.

EXAMPLE: 60 degree Celsius $\times 1.8 = 108 + 32 = 140$ degrees Fahrenheit. **Your machine's oil temperature should not exceed 180 degrees Fahrenheit or 82 degrees Celsius.** If your oil temperature gauge is suspect or inoperative, you can get an idea of how hot the oil is by carefully touching the oil tank. If you can hold your hand on the tank for five seconds, the oil is probably not too hot. If you must immediately remove your hand, the oil is too hot.

Pressure is often given in bar. To convert bar to PSI, multiply by 14.5. **For example, 100 bar = 1450 PSI. Remember, the pressure on the hydraulic system is not the pressure on the concrete.** You would have to calculate the area of the hydraulic piston head, calculate the total force, and then divide that by the area of the concrete piston head. Most boom pumps have a piston face pressure from between 700 PSI and 1000 PSI. High-pressure trailer pumps can have piston face pressures of over 2000 PSI.

GROUT & PEA ROCK PUMPS

There are a number of grout pumps on the market that use a variety of valve systems. The “ball and seat” type valve, the “S” type valve, the “Rock Valve”™, the “squeeze crete”™ valve and others are used to pump grout and pea rock through small placing lines. The manufacturer of these different valves will supply you with a recommended mix design which will usually work with the individual valve.

A line pump is defined as: a pump that pumps grout or a 3/8-inch pea gravel mix through pipe and hose that has a diameter of 2 inches, 2-1/2 inches or 3 inches. The size of any coarse aggregate and the proportioning of the mix will dictate the diameter of the pipe or hose that is required. The ACPA recommends the diameter of the placing line be at least three times and, preferably, four times the size of the largest aggregate in the mix.

Some of the uses for line pumps are small interior or exterior slabs, shotcreting, block filling, tank filling, pressure grouting, soil stabilization and others.

Grout is normally defined as: a mixture of sand, cement and water. The slump is an indicator of the water-to-cement ratio and is generally considered a measure of the flowability of fresh concrete. Depending on the usage, grout may have as low as a two-inch slump for shotcreting, or as high a slump as 10 inches for tank filling. Grout may contain as little as five sacks of cement - 470 pounds, or as much as 10 sacks - 940 pounds of cement per cubic yard. These types of pours are often slow. It may be desirable to request a retarder be added to the mix if a slow pour with high cement content is anticipated. When using high cement content and a high ambient temperature, extreme care should be taken to prevent the mix from setting in the placing line.

The pump operator may make recommendations concerning the mix design or slump, but the contractor has the final responsibility for mix design and slump. The pump operator should NEVER add any water without the contractor or superintendent's approval.

The ACPA suggests you check all fluid levels of your truck and concrete pump before starting the truck or pump engine. On the pump, check engine oil, hydraulic oil, radiator water and flush box water. On the truck, check engine oil and the radiator.

In the cab of your truck, you should have:

- Fire extinguisher
- Safety flares
- Safety reflector
- First-aid kit

Some states also require a fuel permit. Don't forget your personal gear – hard hat, safety glasses, work gloves, rubber boots, operations manual, grease gun and tools. You should also have a good pair of work boots.

When selecting hose and pipe size, it is recommended you remember the rule concerning the diameter of the largest aggregate in relation to the diameter of the placing line. The diameter of the placing line must be a minimum of three to four times the size of the largest aggregate. When it is necessary to pump a long distance, it is recommended steel pipe be used for as much of the distance

as is practical; then rubber hoses for distribution at point of placement. The ACPA recommends only raised-end fittings be used for pipe or hoses. The clamps must be properly adjusted to give a tight fit and gaskets must be used in all clamps.

Make sure all your clamps are complete with gaskets and they are clean. A clamp without a gasket leaks slurry and may cause a plug. It will also leak air, giving you trouble when you try to suck a ball back.

Inspect your hoses daily. Any frayed or worn hoses should be taken out of service because of the increased danger of kinking or bursting. **A kink in the hose can be very dangerous because it almost instantly creates the maximum pressure the pump can produce.**

When beginning to pump, it is important that the first material through the placing line has the ability to lubricate the placing line. Start at the far end of the pour if possible so the system is lubricated on the initial prime. Avoid adding dry system during the pour. If a high-slump, wet-grout is pumped; it may be adequate to lubricate the placing line. When a low-slump or low-cement content grout is pumped, it may be necessary to add additional water to the first hopper full of concrete. When a pea-gravel mix is to be pumped, it is recommended a line lubrication mixture be put into the hopper ahead of the concrete. This lubricating mix may be cement and water or there are several commercial priming products on the market that may be used.

A plug in the line may be caused by a number of problems. It may be caused when starting to pump by a lack of lubrication in front of the grout or pea gravel. It may be caused by dirty placing lines that were not properly cleaned on the previous day. A plug can be caused by the mix bleeding, causing segregation of the sand and aggregate. A plug may occur when larger stones or aggregates that are not designed to be in the mix are dropped into the pump hopper. It is recommended when using small diameter line that a grate with smaller openings be placed on the hopper to prevent large stones or other contaminants from entering the pump.

If plugging conditions in the pump or hose occur for any reason at all, DO NOT attempt to use more power to correct the condition. Reverse the pump or release the line pressure, determine the cause of the plug and correct it. Remove the plug; re-assemble the system using gaskets, clamps and pins, then resume pumping. **Trying to force material through under jammed conditions may result in serious injury to people or damage to the pump or placing line.** If the hose or pipe connected to the reducer and hose starts to move or rise up as pressure is applied, the blockage is down the line. **Check the system until you locate a soft spot in the hose or a hollow sound with a hammer if it is pipe. If the reducer rises up but the hose is soft, you know the plug is in the reducer.**

To prevent death or serious injury, NEVER—repeat—NEVER open a coupling when the placing line is pressurized. Consult the manufacturer's operation manual for the method used to release pressure from the pipeline or hose. Extreme caution must be taken when this condition occurs.

Plugs usually occur in reducers and sometimes in hoses; they have more friction than pipe. To remove a plug when reversing does not work, first relieve the line pressure, then disconnect the plugged system, elevate it and tap on the plugged area with a hammer. Break down the plug and shake it out the end of the hose or pipe. Do not re-hook the system until the plug is removed.

Any time that air is introduced into the line, you must keep all personnel a reasonable and prudent distance from the end hose when the pump is being restarted.

Air will be present in the system:

1. When priming at the beginning of the pour
2. When restarting after a move
3. When removing system from the placing line
4. When opening the line to remove a blockage
5. When adding extra system to the line
6. When pumping and the hopper goes empty

If your pump stops or breaks down, you should first:

1. Notify the job superintendent
2. Notify your office
3. After notification, attempt a repair. If you cannot complete the repair quickly, then;
4. Clean out the placing line
5. Clean out the pump

Immediately upon completion of placing operations, attention must be given to clean out. During some pours, hose and pipes can be cleaned out as they are being removed from the system. **DO NOT leave your machine to help drag hose during the pour.**

When the pour is complete, there are several ways to clean out the placing line depending on the pump you are operating. If you are using a 2-inch or a 2 ½-inch line, you can:

1. Clean out the hopper, dump the hopper or pump the hopper down, and re-hook the hose to the pump with a sponge inside of the hose. Fill the hopper with water and pump the water through the hose until the sponge comes out. **NEVER handle concrete with your bare hands because it contains lime and can burn your skin. If you are pumping back into the mixer truck, you must use a cleanout hook (candy cane) to divert the concrete into the truck. Do not attempt to hold the hose into the truck as it may kink and injure someone.**
2. Dump all hoses and place long hoses with one end uphill and fill lowest end with water. After the hose is full of water, walk the hose in a rolling direction until empty, then repeat using the opposite end. Then be sure that all system and accessories are loaded and secure.
3. **When cleaning inside the hopper, make sure the grate is in place and properly secured or disable the hydraulic system and verify zero pressure on the accumulator.**

When pumping and cleanout operations are completed, make sure your unit is safe and ready for travel back to your yard. Check to make sure the safety chains are properly fastened and the tongue jack and outriggers are raised and locked in position. Do a final walk around the truck and pump to be certain there are no loose objects that may fall off during travel.

LINE PUMPS GENERAL AND HIGH PRESSURE

Before your trailer pump leaves the yard in the morning, visually check the condition of the truck and the trailer. Verify the hitch is closed and secured; the safety chain is on, air and electric connections are working and double check all safety pins.

Make sure all equipment on the bed of your truck is safely stowed. Be sure you have the correct driver's license, job ticket, registration and proof of insurance. A truck equipped with air brakes, or having a GVWR over 26,000 pounds, requires a CDL license. Be sure you have the proper safety equipment including a hard hat, work boots, rubber boots (for washing out), work gloves and safety glasses. Be sure you have the necessary tools, including grease gun and an operator's manual for the pump. Check your job ticket to make sure you have all of the system and clamps for each job that day and confirm that you know where you are going. Be sure you know the location of the emergency stop buttons, they operate properly and you know exactly what they disable. When driving down a steep hill, use one gear lower than the gear you would use to go up the hill.

At the job site, park safely off the road and contact the job superintendent or designated person, survey the work to be done; then set up your trailer pump. Locate your pump to provide good access for two ready mix trucks (if possible). When placing the pump, consideration should be given for repeated delivery by ready mix trucks. Now would be a good time to locate the washout water on the job site, if possible.

Make the placing line as short and straight as possible. A sweep 90 degree bend (one meter radius) creates as much pressure as nine feet of straight pipe; while a short 90 degree (250 mm radius) creates the same pressure as three and one-half feet of pipe. Whenever possible, move the pump until you can clamp the steel pipeline directly to the pump reducer. Avoid using a rubber hose between the pump and the placing line. Then run pipe as far as you can. Use as little hose as possible. It is three times as hard to pump through rubber hose as steel pipe. Ten feet of rubber hose equals 30 feet of pipe in pumping effort.

Install your standpipe using proper gauge pipe at the bottom and only put thinner wall pipe near the top. Remember, a higher gauge number means a thinner pipe wall. A 7-gauge pipe is thicker than an 11-gauge pipe. All the concrete poured on a high-rise goes through the bottom of the standpipe first, creating the most wear, while the upper standpipe gets the least wear. For safety reasons, know pump piston face pressure and your placing line working pressure. The pressure is always highest at the back of the pump. That means line placed there must be able to tolerate the maximum pressure of the pump. Remember, smaller concrete cylinders produce higher concrete pressure. Always consult the manufacturer if in doubt.

If you do not have a proper method to check the thickness of used pipes, it is suggested you use new pipe for a high-rise.

THE ACPA RECOMMENDS TO:

Use raised ends on the placing line for greater safety as raised end placing line will withstand higher pressure. Try to finish the pour as close to the pump as possible. This reduces waste and mess. A useful rule of thumb is:

300 feet of four-inch placing line contains one yard of concrete

200 feet of five-inch placing line contains one yard of concrete

Always prime the pump and placing line with a mixture of slurry ahead of the concrete. You can use cement and sand from the job site. You can have the contractor order a yard of two parts sand to one part cement or 9 sack slurry to be delivered by the first truck. In any case, do not attempt to start pumping without priming. Spraying water in the hopper and wetting up the first load is not acceptable, and 50 men will be standing around, on the clock, waiting for you to unplug the placing line. The ACPA does NOT recommend using the “just wetting” method.

Make sure all your clamps are clean, complete with gasket and pinned. A clamp without a gasket leaks slurry and may cause a plug. It will also leak air, giving you trouble when you try to suck a ball back or blow out the line with compressed air.

Inspect your hoses daily. Any frayed or worn hoses should be taken out of service because of the increased danger of kinking. Kinking can be dangerous because it almost instantly builds pressure to the maximum pressure the pump can produce. It can cause a hose or pipe to rupture, spraying concrete everywhere. It can cause the hose to jerk violently. It can cause a hydraulic line to burst. It can blow the end off a hose or burst a clamp. Anyone near the placing line may be injured.

During the pour, grease the pump's seals and bearings according to the manufacturer's prescribed intervals.

Plugs usually occur in reducers, and sometimes in hoses because they have more friction than pipe. To remove a plug when reversing does not work, first relieve the line pressure, locate the plug, then disconnect the plugged system, elevate it and tap on the plugged area with a hammer. Break down the plug and shake it out the end of the hose or pipe. Do not re-hook the system until the plug is removed.

Any time air is introduced into the line, you must keep all personnel a reasonable and prudent distance from the end hose when the pump is being restarted.

Air will be present in the system:

1. When priming at the beginning of the pour
2. When restarting after a move
3. When removing system from the placing line
4. When opening the line to remove a blockage
5. When adding extra system to the line
6. When pumping and the hopper goes empty

If your pump stops or breaks down, first:

1. Notify the job superintendent
2. Notify your office
3. After notification, attempt a repair. If you cannot complete the repair quickly, then;
4. Clean out the placing line
5. Clean out the pump

Proper safety gear on a high-rise project includes a hard hat. This is very important for the pump operator, who typically works right at the base of the building and is exposed to falling debris. Many local ordinances require a canopy for the operator. It is imperative to have a good communications system between the operator of the pump and the placement point of the concrete.

Pressures in a standpipe can be very high. **It should be noted that the pressure gauge at the concrete pump ONLY indicates hydraulic pressure - not placing line pressure.** Pressure in the concrete delivery placing line rises as the hydraulic pressure of the pump rises. (Use caution when high pressures are observed.) Remember - the placing line pressure is always greatest at the back of the pump and decreases as you go up the standpipe. **To help imagine the pressure, remember that pumping up 200 feet is equal to pumping 800 feet straight out. A cubic foot of standard concrete weighs 150 pounds, meaning that just one 10-foot section of five-inch pipe contains 200 pounds of concrete.**

HIGH-RISE PUMPING

A pump capable of pumping high-rises typically is a pump that generates higher pressures. Extra care should be taken when operating a high-pressure pump.

With vertical runs of 100 feet or more, a concrete thrust block should be used at the bottom of the standpipe and you must securely fasten the placing line. This will keep the pipe from moving and causing damage.

Be sure to use a shut-off or switching valve in the line right after the pump. This allows you to hold the concrete in the standpipe when you are done pumping, so you can disconnect the pump and hook up the cleanout pipe to direct the waste concrete into a trash area or back into a ready mix truck. **Sometimes a diversion valve is used instead of a shut-off valve. This allows the waste concrete in the standpipe to go in two directions: either back to the pump hopper or to the cleanout pipe.** The pipe from the valve to the cleanout area must include a slurry tee.

When the job is negotiated, it is important to clearly state who will be responsible for maintaining and checking the placing line, as well as cleanout procedures. This includes checking the wear and securing the pipeline. The concrete pump operator should be aware of this agreement.

Take care when pumping lightweight concrete. **Because it is porous, it may absorb water under the pressure of pumping. This reduces the slump of the concrete, which leads to higher pumping pressure and possible plugs.** High-rise pours require one cubic yard of 9-bag grout for priming. The use of commercial primers or water is not recommended for high-rise pumping.

If more water is needed, it should NOT be added by the concrete pump operator. Only the person(s) responsible for the pour should add water because this changes the mix design. Too much water in the mix can cause the rock and sand to separate, causing a plug. This is called segregation.

Be aware of admixtures in the concrete. A commonly used admixture, calcium chloride, speeds up the setting of concrete. This has caught many a pumper unaware. Wear gloves and safety goggles when washing out. The lime in cement can cause concrete burns.

**NEVER - NEVER REACH INTO THE CONCRETE
PUMP VALVE FOR ANY REASON, NEVER!
ALWAYS USE THE SPECIAL TOOLS!**

Do not remove the grate from the hopper or operate the pump without a grate on the hopper. NEVER reach in the hopper for any reason when the pump engine is running or the agitator is turning - steel cannot tell the difference between concrete and human hands. The agitator can kill you. Before you remove the hopper grate, you must turn off the engine and verify zero pressure on the accumulator gauge as well as utilizing a proper lockout/tagout procedure.

COMPRESSED AIR TO CLEAN OUT

Be extremely careful when using compressed air to clean out the placing line. Follow the manufacturer's recommended procedures for cleanout.

1. Cleaning with air requires two trained people.
2. All pipe added to the discharge end of a pipeline for diverting the concrete must be lubricated either by using a grout tee or adding slurry before connection.
3. NO PERSON is allowed to be near the concrete discharge end of the pipeline.
4. A catch basket should be used and the outlet must be controlled.
5. The discharge pipe should be positioned high enough to permit easy discharge of concrete.
6. All rubber hoses should be removed from any line to be cleaned with compressed air unless the hose is part of an attachment specifically used for cleanout into a ready mix truck.
7. The sponge or plug must be sufficiently tight to prevent compressed air flow around the plug into the concrete.
8. Work on the pipeline is allowed only after a pipeline has been relieved of compressed air. Insure air pressure has been completely relieved.
9. You must have a good reliable method of communication between the pump operator and the crew at the end of the pipeline.
10. Wear gloves and safety goggles when cleaning out. Lime in concrete can cause concrete burns.

The cleanout should be started within five minutes after pumping is completed. Any delay could possibly cause a plug, so it is important to plan ahead and be prepared.

When you are finished pumping, remove the discharge hose from the end of the pipeline.

Coordinate with the pump operator to verify that the shut-off valve is closed. Connect the pump line at the shut-off valve to the discharge line if applicable. Remember to lubricate the discharge line. If you are going to discharge into a bucket, place a cover over the bucket to eliminate splatter, and secure the discharge line to the bucket.

Insert a sponge or go-devil into the end of the placing line. Connect blowout cap onto placing line. Do not connect air. Verify that the air valve and bleeder valve are closed. Blowout caps must have an air inlet and a bleed valve placed far enough apart that the sponge can't cover both at the same time.

Communicate with the pump operator that you are both ready. When ready, connect the air hose to the blowout cap, but do not turn on the air. Open the bleeder valve so air can enter the pipeline - allowing the sponge to be sucked back.

When you are both ready, the operator should open the shut-off valve or throw the switching valve, diverting the flow of concrete to the discharge. The weight of the concrete should start the concrete moving.

Once the concrete is moving, the operator on the ground should direct the deck crew to close the bleeder valve and slowly add air. Using the air valve, add only enough air to keep the concrete moving. DO NOT TURN THE AIR ON AND LEAVE IT ON.

If the concrete begins to move rapidly, close the air valve and open the bleeder valve to slow it down. By gently adding and bleeding air, the sponge can be gently and safely expelled.

If the concrete stops moving or never moves at all, it may be necessary to break the placing line down and clean it in shorter sections. Before any work is done on the placing line, and before any clamp is opened, it is imperative to absolutely ensure that all air is bled from the placing line.

After the blowout is completed, retrieve all disconnected hoses and pipe and clean them out.

MULTIPLE-SECTION BOOM PUMPS

Operating a truck-mounted boom concrete pump requires tremendous responsibility and having a clear strategy for each day's pour to provide for your own safety and that of your co-workers.

SAFETY REGULATIONS – MOBILE CONCRETE PUMPS EQUIPPED WITH PLACING BOOM:

Read the operation manual for the machine. It describes the safe, proper and most efficient way to operate. Know your machine!

Following are some supplementary recommendations:

1. All safety devices and provisions against accidents, such as warning labels and information signs, etc. must be in place. Do not tamper with them. If they are missing, replace them.
2. Check the operational reliability of the machine each time before it is put into operation. Any serious defects found must be repaired immediately.
3. Allow the machine to be operated and maintained by qualified personnel only.
4. Make use of handles and steps when ascending or descending. Use the "THREE-POINT RULE".
5. Keep steps, platforms, control and monitoring devices in good working condition as well as free from dirt, oil, snow and ice.
6. Before leaving the machine, protect it from unauthorized use and unintentional movements.
7. Unauthorized presence in the immediate area of the concrete pump and the placing boom is NOT allowed. Warn persons who are in the immediate area. Stop work if person(s) do not leave the area after having been warned.
8. Wear personal protective clothing and equipment when operating the machine.
9. **The placing boom may only be operated up to a maximum wind speed of 48 MPH (77KPH) wind force, or per manufacturer's instructions.**
10. Under all circumstances, keep sufficiently away from obstacles such as: boom cranes, scaffold, buildings, etc.
11. **The placing boom must NEVER be used as a crane for lifting objects or material - repeat - NEVER.**
12. **DANGER! HIGH VOLTAGE! DANGER TO LIFE! KEEP DISTANCE! MAXIMUM PERMISSIBLE APPROACH TO POWER LINES IS 20 FEET (SIX METERS) (50 feet when the voltage exceeds 350kv).**
13. **Only 1 (one) tip hose may be safely hung from the tip of any placing boom.** The weight of the end of the hose must not exceed the weight specified in the operation manual of the manufacturer. The end hose MUST NOT be kinked during pumping operations. The safety cable or strap between the boom and the end hose must be in place, attached and in good condition. The anchor point for a safety sling should be the boom itself, not pipeline.
14. If the end hose is replaced with any combination of reducer, hose or adapter (for example, a

five-to-four reducer and a four-inch hose), then any and all hoses, reducers, etc. must be fastened with safety cables or straps and may not exceed the weight recommended by the manufacturer. All of the above-mentioned items must be capable of handling the pumping pressures of the specific pump used. Any and all snap clamps used to secure a placing line that will hang above workers must be locked with a pin.

15. The tip of a placing boom should never be connected to a pipeline without using an approved concrete delivery hose between them.
16. When pumping, the placing boom should never be tied down or placed on the deck.
17. If the placing boom starts to bounce, you should slow down the concrete pump, adjust the stroke limiter or adjust the throttle valves.
18. Perform all maintenance and lubrication of the boom at the manufacturer's prescribed intervals.
19. Using the manufacturer's recommendations, do a complete boom and tower inspection annually.

Responsibility for a safe and successful day begins when the operator arrives at work on time, rested and with a clear head. One of the most important items for a safe work day is: **ALWAYS ARRIVE ON TIME** so that a proper equipment inspection can be performed. Before starting your engine, check all fluid levels, engine oil, hydraulic oil, coolant level, and if so equipped, power steering and hydraulic brake fluid. If the pump has a separate engine, also check fluid levels before starting. It is now possible to start your engines. While climbing into the cab, always remember the "THREE-POINT RULE" - Always have one hand and two feet, or two hands and one foot in contact with a secure step or handle. The three-point rule also applies to climbing on or off the pump deck or any other piece of equipment.

Just prior to starting your engine yell "CLEAR" after assuring that no one is near or close to the engine being started.

After starting the engine, feather the throttle but do not "rev" the engine, as this may cause permanent damage to a turbocharger or other components on the pump. Check that all onboard systems like oil and air pressures are reading normal and the electrical system is charging.

After you are satisfied your power train is properly functioning, you should make certain the pump system is operational. Check with suggested procedures outlined in the operations manual of your pump for the details of pre-job check.

While still in the yard, walk around the vehicle and check for loose wires, proper operation of lights and tire condition, even if you checked it the night before. Also check to make certain the concrete pump hydraulic oil, water and grease levels are all at proper capacity. Always check the outriggers to ensure they are properly pinned for travel.

Check and restock all emergency spare parts, hoses, fittings, elbow and pipes. Ensure all safety equipment is in place before leaving the yard. (Safety glasses, hard hats, fire extinguisher, road flares and first-aid kit.) Check all documentation:

1. Current registration
2. Insurance card
3. Driver's license/health card
4. Permits: fuel /operation/ overweight
5. Business license

If anything is missing, or is not in order, report this to the supervisor immediately.

If you have not done so already, make sure you have all necessary system, safety straps, clamps, reducers and cleanout supplies on the pump. Do a mental inventory of what you may need to complete the job properly and effectively. Try to visualize the anticipated job conditions and any potential problems you may need to overcome. Always consult with the dispatcher and/or your supervisor for any information they may have on the job. It's better to be prepared than caught short. Always get proper directions to the job, ones that you can understand. Consult a map, if necessary. Don't forget your job ticket(s). It's your job and responsibility.

Drive defensively, courteously and safely to the job. Obey all traffic regulations, including speed limits and travel restrictions. DO NOT TAILGATE! If you know you are going to be delayed for some reason, contact your base to alert the job.

While driving to and from the job, remember the principal causes of truck accidents:

1. Following too closely
2. Backing up without supervision
3. Turning too sharply
4. Hitting something overhead
5. Inattentive driving (including talking on the phone)

Remember to utilize your engine to control your speed when coming down a hill. You should use one gear lower than the gear required to climb a hill. Remember, concrete pumps are equal to a fully loaded truck. A 92- foot boom truck weighs approximately 46,000 pounds, a 118-foot boom truck about 60,000 pounds and a 138-foot boom truck about 70,000 pounds. Most pumps are about 13 feet high. The Federal Limit is 13-1/2 feet. (Note: same in Canada.)

When you arrive at the job, securely park the vehicle and report to the job superintendent. Go over the pour plan with the superintendent or designated foreman. Make sure you have a safe designated area for cleaning up the pump. Point out any safety problems, access problems or potential operating difficulties, such as power lines, when you walk the job prior to set up. The ACPA has adopted the position that if electrical wires are within 20 feet of the area to be poured (50 feet when the voltage exceeds 350kv); a dedicated spotter will be employed. His only job is to monitor the movement of the boom and warn the operator if the boom approaches closer than 20 feet (50 feet when the voltage exceeds 350kv) to the wires. Remember the most common cause of fatal accidents involving concrete pumps is electrocution. It is important to note the ACPA recommendations never supersede

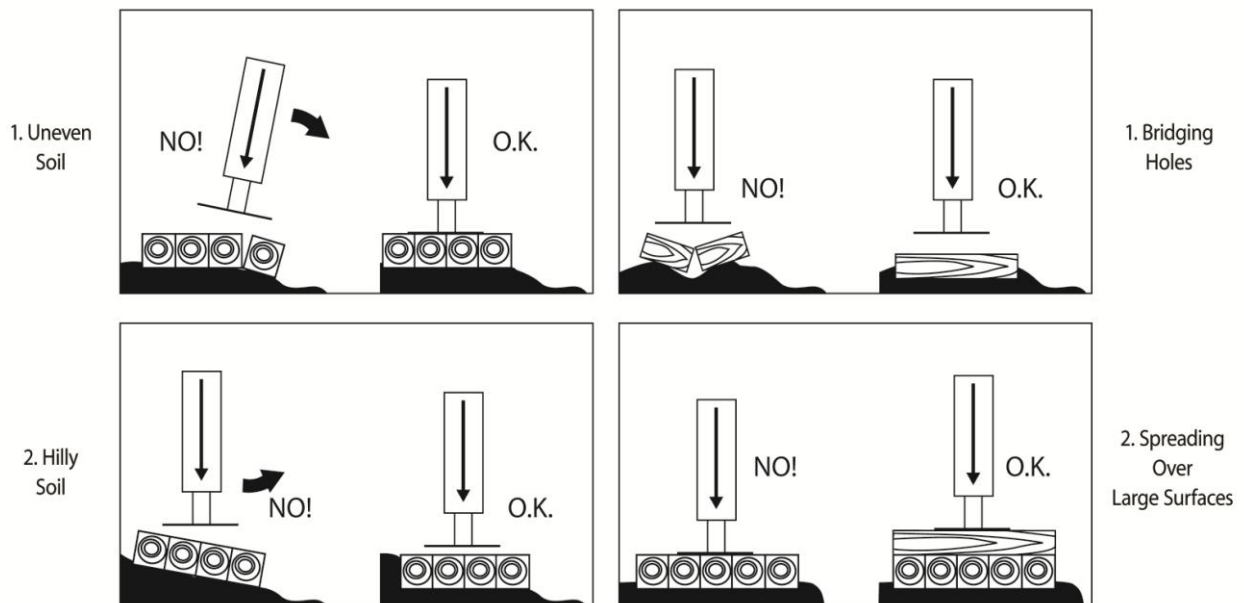
local, state/provincial or national law. **DO NOT set up in an unsafe situation, even if the superintendent directs you to do so.** Call your office for help. Remember the ready mix trucks with repeated deliveries to an off-street construction area have a tendency to tear up your access when leaving. This may also affect discharge into the hopper.

No person is allowed on the pump except yourself, and **NOBODY is to stand on your hopper grate - for any reason, whether the pump is in operation or not. This is called the “NO POINT RULE”.**

Clean the potential setup area of all debris and position pump so that any obstructions (power lines, ditches, walls, columns, etc.) do not interfere with safe and proper set up and operation. Once in position, set parking brake, select the proper gear, engage the PTO or start up the auxiliary engine (if so equipped).

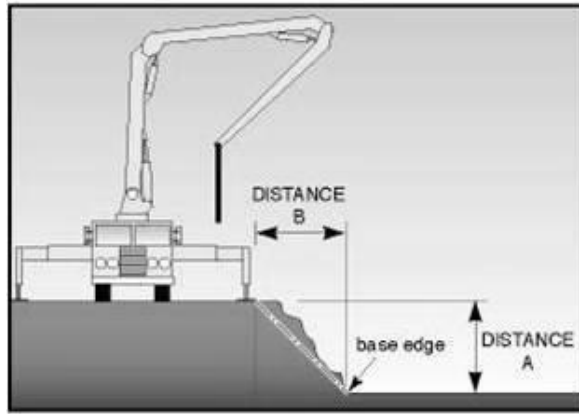
Extend all outriggers fully and lock into place. Use outrigger pads supplied by the manufacturer even if setting up on concrete.

The ground beneath the pads must be level. If it is not, you must make it so.

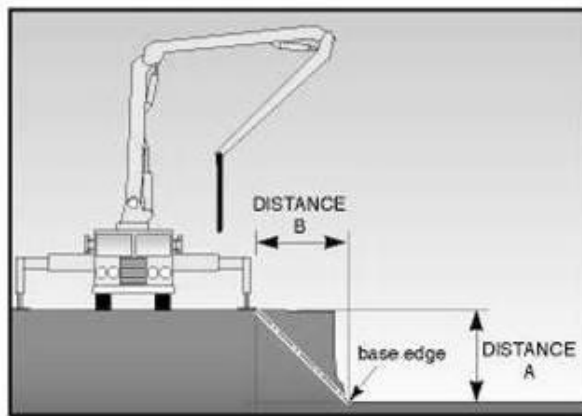


After the outrigger pads are in place, put the full weight of the unit on each outrigger as you jack it down. If the pad begins to sink, retract the outrigger and use cribbing to increase the size of the pad. Repeat this procedure until the cribbing doesn't sink. Keep away from any open cut ditches, box culverts, curbs and unsupported sidewalks. If you are close to an open cut, make sure your outriggers are set back from the base edge at least the same distance that the ditch is deep. For example, if the ditch is five feet deep - the outrigger pad should be back a minimum of five feet from the bottom edge of the ditch. This is known as the “ONE-TO-ONE RULE”. Be sure the bank is not under cut. If you cannot stabilize the outriggers, you must relocate the pump or not set up!

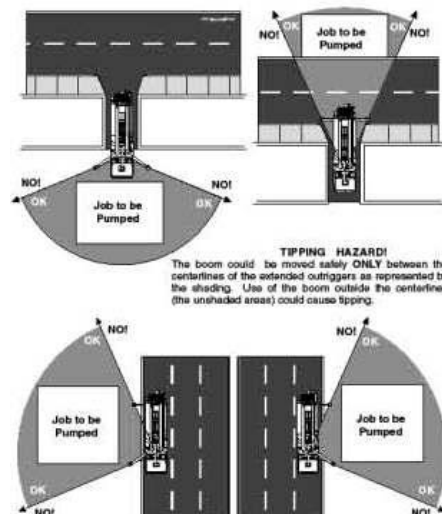
(See examples on next page)



The One-to-One Rule: For every one foot of vertical drop, stay back from the base edge one foot. (Distance "B" must be equal to or greater than Distance "A")



Outrigger force is transmitted at a 45-degree angle from the center of the outrigger pad. If the area is cramped, it may not always be possible to fully extend all the outriggers. This situation should be avoided if at all possible, but if there is no other way, the outriggers that will feel the weight of the boom must be fully extended and jacked down. The outriggers on the side away from the pour should also be jacked down. The boom must not rotate beyond an extended outrigger toward a non-extended outrigger unless specifically approved by the equipment manufacturer.



If your outriggers are unstable when the boom is folded, the negative effect will be multiplied when the boom is deployed. Next, insure you unload the truck carrier springs by bringing up the pump frame into a horizontal and level condition. **It is important the truck springs are unloaded and the pump is within three degrees of level, (no tension or weight on them), otherwise the boom bounce can be a nuisance to the placing crew.** Depending on the make and model of the pump, different manufacturers have different procedures for suspending the pump. For those designed to incorporate the truck and pump as a counterweight, refer to manufacturer's recommendation. Others, whose pump and truck are actually the boom's ballast, do not require that the truck tires be suspended. In either case, the tires should be blocked to prevent any unnecessary bounce or rolling action. Always consult the operator's manual for each specific pump before on-site operation. **All truck-mounted boom pumps are required to be level within three degrees for safe operation.**

It is important to follow proper manufacturer's procedures for unfolding the boom. Make certain all boom sections are unfolded in proper sequence and safety hooks or straps used for transport are not bent or binding. **NEVER force the boom if it is in a bind. First, relieve the pressure off the cylinders by actuating the opposite control which possibly placed the boom into a bind. Next, check to see which area is binding or what is causing the boom to rub or bind. Eliminate that problem before attempting to further unfold the boom.** You could be seriously injured if you attempt to spring the boom or manually unhook it. Remember the hydraulic cylinders will store energy and in combination with the structural mass of the boom, can react similar to the fishing pole of a fly caster. If in doubt - ask for help. If the end hose is replaced with a combination of reducers and hose, (for example: five-to-four reducer and four-inch hoses) then any and all hose, reducers, etc. should be fastened with safety cable or straps and may not exceed the weight of the recommended end hose. Any of the above-mentioned items should be capable of handling the pumping pressures of the specific equipment.

Before rotating your boom, always remember to note the location of boom stops and limit switches. Never over-rotate the boom as you may easily rupture a hydraulic line in or on your turret. This could create additional work, expenses and could create a safety problem.

Once the boom is unfolded, carefully rotate and extend the boom over each outrigger. If the outrigger pad sinks or is unstable, place the boom over the other side of the truck or refold the boom, lift up the outrigger and increase the size of the cribbing. Repeat this procedure until all outriggers are stabilized. If you are unable to stabilize the unit, you must relocate or not do the pour. Continue to check the outriggers for sinking throughout the pour.

When priming or restarting the pump after a move, keep all personnel a safe and prudent distance from the discharge. If a plug occurs, the hose can whip violently.

Any time air is introduced into the line, you must keep all personnel a reasonable and prudent distance from the end hose when the pump is being restarted.

Air will be present in the system:

1. When priming at the beginning of the pour
2. When restarting after a move
3. When removing system from the placing line

4. When opening the line to remove a blockage
5. When adding extra system to the line
6. When pumping and the hopper goes empty
7. When reversing the pump for any reason

Whenever air has been introduced into the line for any reason, warn everyone to stay away from the discharge until material runs steadily. Personnel should move a prudent and reasonable distance beyond the end-hose movement area or the point of discharge, and personal protective equipment (PPE) should be worn.

Do not let the concrete level in the hopper become low! If air is sucked into the material cylinders, the pump will compress the air. Compressed air always poses a hazard as it is expelled from the hopper or the delivery pipeline. **If air is taken into the material cylinders, take the following steps to minimize the hazard:**

1. **Stop the pump immediately.** Hit the emergency stop button if that is the quickest way to stop the pump. There will be an expulsion of compressed air the next time the concrete valve shifts, which can be safely absorbed by filling the hopper with concrete.
2. **If possible, fill the hopper with concrete to just below the grate, then pump slowly in reverse for several strokes.** This will not remove all the air, but it should minimize the amount left in the pipeline.
3. **Persons standing at the discharge end, or near the delivery line, must be warned to move away until all of the air has been purged.**
4. Personnel should move a prudent and reasonable distance beyond the end-hose movement area or the point of discharge, and personal protective equipment (PPE) should be worn.
5. **When the pump is restarted, pump forward slowly until all air is removed from the pipeline.** Don't assume the first little air bubble is the end of the compressed air.
6. Do not allow anyone near the discharge until concrete runs steadily from the end and there is no movement of the delivery system.
7. If workers are positioned in high or precarious places, warn them to expect a loud sound as the air escapes the pipeline. (Warn them even if they are well away from the discharge.) That way, we can prevent the worker from falling as a result of being startled by the noise.

It is best to prime outside of the pour as the contractor may not want the primer in the pour, and the primer may be slippery - creating a slipping hazard.

Hose whipping can also be caused when you encounter a mix that is difficult to pump and is causing unusual hose movement. When this happens you must stop pumping and correct the problem. Some solutions are:

1. Removing reducers and smaller hoses from the tip of the boom
2. Try a different load of concrete
3. Ask the contractor to add some Portland cement, water or plasticizer
4. Change the mix to a more suitable mix design

If you are unable to correct the problem and there is still unusual hose movement, you must

discontinue pumping until the problem is solved.

Frequently inspect all boom clamps and pipe before, during and after each pour. In all cases, use safety straps, cables, chains or other restraining devices on any hoses or reducers suspended from the boom's end. **NEVER DRAG HOSES SIDEWAYS WITH THE BOOM** as it causes undue stress to the boom; it may catch or cause a clamp to open and may cause machine instability.

NEVER hook the boom tip directly into pipeline. Always use a high-pressure rated concrete delivery hose when you hook your boom into a line. This gives the flexibility the boom needs to move up and down a little. Be sure the tip of your boom does not touch the deck. If your boom starts bouncing too much, check your outriggers to be sure they are firm and level on their pads. If the boom still bounces too much, adjust the pump speed with the throttle or volume control until the boom smooths out.

If a lightning storm approaches, lower or fold your boom and seek shelter.

NEVER turn your controls over to any non-qualified individual, and if you are momentarily away from your pump, make certain your hydraulic system is disabled by engaging the emergency stop switch or taking the pump out of gear.

If your pump stops or breaks down, first:

1. **Notify the job superintendent**
2. Notify your office
3. After notification, attempt a repair. If you cannot complete the repair quickly, then;
4. Clean out the placing line
5. Clean out the pump

When you are finished and moving your boom to the cleanout position, make sure everyone stands clear so they are not hit with any loose rock that may spill out of your tip section. **It is important that you NEVER move the concrete pump without folding the boom and outriggers to the proper travel position.**

To clean out your boom, make sure your concrete level in the hopper is low, place a ball or sponge into the tip section and stand the boom straight up, reverse the pump and suck concrete back into the hopper until the sponge returns to the hopper. In all cases, follow the recommended cleanout procedures prescribed by each manufacturer. When you wash out the hopper, be sure to do so in an approved location. Before moving to the cleanout area, open the transition to prevent accidentally pumping the sponge back into the deck pipe. After the boom is folded up, attach your tie-down safety strap (if your machine has one). **NEVER REACH INTO THE VALVE OR WATER BOX unless the transmission is out of gear and you have verified zero pressure on the accumulator!**

There are several things to remember regarding job-site courtesy. You are your company's representative on the job. The way you handle yourself, any problems which may arise or the way you interface with other job site personnel will play a critical role in the successful performance on the job. Keeping a level head when things go wrong will yield better results and gain respect for you and your company. Your efforts, cooperation and attitude will determine if your company will be called back to the job or to some future projects.

Before you leave any job, make certain all your hoses, clamps and tools are replaced and properly stowed on your equipment. Don't leave a mess and always GET YOUR TICKET SIGNED.

50-METER CLASS

Operating a 50-meter or larger boom requires more experience, more caution and more attentiveness from the moment you step inside the cab until you shut off the engine at the end of the day. Because of the sheer size, larger turning radius, length and weight, more caution is required driving to the job. More stopping distance is required, so it is more important to arrive on time, plan your route and know your exit. The decks have less storage room so more time is required to secure your load before departure. It is recommended that you arrive on the job at least one hour before concrete time to allow for a safe set up.

When you arrive on the job, stop in a safe area before driving into unknown soil conditions. A 50-meter or larger concrete pump weighs more than 105,000 pounds. The twin and triple front axle trucks have a greater plowing action so you must drive slowly and carefully. Always check in with the job superintendent and discuss the setup area and review the ground conditions in the setup area before moving off the maintained road.

When you arrive at the setup location, because your reach is so much greater, you must check even closer for power lines, overhead obstructions and other obstacles both in the area of the pour and behind the pump as the extra reach makes it easier to get into trouble.

It is recommended that a 50-meter or larger boom never be short-rigged without an integrated short-rig detection system. Always fully extend and jack all outriggers. Always use the large outrigger pads supplied by the manufacturer for this purpose, even when setting up on concrete. A 50-meter or larger boom can exert over 60,000 pounds on any one outrigger. The small swivel foot pad could punch through solid concrete when used without proper cribbing. Many soil types require more cribbing than the manufacturer's pads. In those cases, use the manufacturer's pads on top of your cribbing base.

One of the most common problems with a 50-meter or larger boom occurs when an outrigger punches through the cribbing or the cribbing sinks into the soil allowing the pump to tip over. Before setting up, find out if the setup area has been backfilled or is adjacent to a backfilled area. Also find out if any underground tanks, plumbing or other disturbed soil exists. If you are setting near a backfilled trench, you must consider the trench as an excavation and use the one-to-one rule by setting the outrigger back from the edge of the backfilled trench at least the depth of the trench. Outriggers must be set back from the bottom of any excavation a distance at least equal to the depth of the excavation.

Before setting your cribbing, refer to Chapter II in the General Rules of the Safety Manual for calculating soil pressures. If you cannot stabilize the outriggers, you must relocate the pump or not set up!

When setting your cribbing, it is important to level the area before starting. Many of the outriggers

have a swivel pad that can allow the outrigger to slide off of un-level cribbing. After the outrigger pads are in place, put the full weight of the unit on each outrigger as you jack it down. If the pad begins to sink, retract the outrigger and use cribbing to increase the size of the pad. Repeat this procedure until the cribbing doesn't sink. Keep away from any open-cut ditches, box culverts, curbs and unsupported sidewalks. Once the boom is unfolded, carefully rotate and extend the boom over each outrigger. If the outrigger pad sinks or is unstable, place the boom over the other side of the truck or refold the boom, lift up the outrigger and increase the size of the cribbing. Repeat this procedure until all outriggers are stabilized. If you are unable to stabilize the unit, you must relocate or not do the pour. Continue to check the outriggers for sinking throughout the pour. When setting the outrigger on an existing slab or footing, keep the center of the outrigger back three feet from the edge. The pump can "rock" or "surge" forward and slip off the edge of the slab. Also, the slab can break easier near the edge and can allow the outrigger to sink or tip.

When the operator is requested to operate the boom from a position away from the closest point of the outrigger structure, it is imperative to have a competent person to monitor the concrete pumping operations as well as the outrigger structure. This person must be trained in the operation of the emergency stop, be able to safely and correctly guide the concrete delivery trucks to the concrete hopper, to not let the hopper run low or empty, to watch for mechanical problems, and very importantly, to watch the stability of the outrigger structure. This person should be instructed that it is not acceptable to leave the concrete pumping operation unattended. It is recommended that this person have two-way verbal communications with the concrete pump operator.

When priming the boom, proper grouting techniques are critical. Grouting techniques may vary by company, by the geographic area that you are working in and/or by the concrete mix design that you are to pump. In most cases, a yard of pre-mixed primer grout is considered the most dependable method and therefore recommended. Although plugging up during the priming process of any size boom is not desirable, with a 50-meter or larger boom it is even more important to prime up successfully for each pour. Be aware the boom can sag up to 10 feet when being loaded with concrete. Sagging can also occur when restarting the flow of concrete into the boom during the pour. Use caution when restarting because if the end of the boom comes down and kinks the tip hose while pumping, a serious accident could occur. If extra hoses or pipe are added to the end of the boom beyond the tip hose, the weight must not impose an additional load on the end of the boom as it may cause tipping or damage to the boom.

During the pour, frequently check the stability of the outrigger pads. If they are sinking or tipping, fold up the boom and reset the cribbing. As you retract the boom, watch the area behind you because the boom can extend far behind the pump.

Some booms have restricted areas in which the boom cannot be operated because too much weight is exerted behind the turret. You must be aware of these limitations. While pumping, you may experience some boom bounce, which can be minimized by adjusting the pumping speed.

If you end up with a completely full boom, you will end up sucking back nearly one yard of concrete. It is important to end up with an empty hopper and have somewhere to discharge

the excess concrete. You must be extra careful when unfolding the boom from the travel position or returning it to the travel position as some four-section booms can hit the cab of the truck during this process. It is recommended that an extra person be available to stay with the operator after the pour and guide him off the site.

**A PUMP OPERATOR'S FIRST
RESPONSIBILITY IS ALWAYS SAFETY!**

SEPARATE PLACING BOOMS

Upon arrival at the job site, you should first check in with the job supervisor.

Inspect the operation and condition of the concrete shut-off valve.

Verify that the go-devil catcher is located at the blowout position, if required.

Test your two-way radio before going up to the placing boom.

Inspect the pipeline as completely as possible and verify that the pipeline is connected to the mast being used. Verify all clamps are closed tight and pinned.

Check the support of the mast for proper pins or wedges and supports. Inspect the floor frames for proper installation and bracing wedges. Four wedges are required per floor frame. Some tower crane type masts require eight wedges.

Inspect ladder sections for safe attachment. If the mast has a work platform, verify proper trapdoor operation and condition of safety posts and rails.

Remove all debris from the work platform; and store tools, water and food so it will not interfere with safe boom operation.

Inspect bolts or pins holding the placing boom to the mast. Verify that any keeper pins or bolts are intact.

Visually inspect the placing boom and mast for structural integrity. If a defect is found, do not operate the unit until the defect has been repaired. The pressure and wear are greatest at the end closest to the pump. Pipeline should be checked with an ultrasonic thickness tester before installation and periodically during the job.

Before rotating the boom, check the hydraulic hoses in the mast to be sure you don't twist them around and tear them out.

Verify air, sponge and blowout cap are available for cleanout. The blowout cap must have two valves; one to bleed air out, and one to let air pressure in. The valves must be spaced far enough apart that a blowout ball could not block both openings at once. Be sure the air compressor is available for cleanout and that it is operational. Verify re-shoring has been installed as the strength of the concrete alone may not support the boom and mast.

DIESEL-DRIVEN PLACING BOOMS

Check the diesel motor and hydraulic reservoir for proper oil level. Always use anti-foam type hydraulic oil. Inspect the air, oil and fuel filters in accordance with the manufacturer's instruction. Verify that you have adequate fuel to complete the job. Be sure the power pack is situated as not to interfere with other equipment or the section of the building that is being poured.

ELECTRICALLY-DRIVEN PLACING BOOMS

The power supply on construction sites, according to Article 305 of the National Electrical Code, may be taken ONLY from a special feed point, such as an electrical distribution box with current-operated ground protection. **The connection of the power supply cable to the feed point or any repairs on this cable must be carried out only by a qualified electrician.**

Fuse protection and conductor size are the responsibility of the electrician and should comply with the National Electrical Code and any other locally required electrical codes. To prevent damage to the cord and plug, it's recommended that the power cable not be used by other trades when not being used for the placing boom.

The power supply connection for electrically-driven stationary concrete pumps, or the electrical power packs for placing booms, has to be arranged by the contractor. **Normal power source for the United States is: 440 to 480 volts, AC, 3-phase, 60HZ.** A designated power line to the placing boom is always best to avoid power surges, which may burn out relays and other controls necessary to control all functions.

Inspect the electrical connection between the power source and the placing boom. **If the cable is wet, frayed or damaged, DO NOT attempt to repair. Repairs must be done by a qualified electrician.** Check the hydraulic reservoir of the power pack for proper oil level in accordance with the manufacturer's instructions. **Always use anti-foam type hydraulic oil.**

COMPLETION OF THE POUR

Coordinate the system cleanout with the pump operator according to the safety instructions outlined in the pump operation manual. Refer to system blowout procedures earlier in this manual. All rubber hoses must be removed before blowing the placing line. NEVER use compressed air to clean a rubber hose or short section of pipe (less than 40 feet). Be certain there is no one in the discharge area before blowing the placing line. **It is necessary to lubricate the cleanout line with grout before beginning to clean out.**

Shut off the power at the placing boom power pack. Clean up the work area.

Walk down the placing line and inspect for leakage, dents, cracks or worn system. Replace any part of the placing line that needs it.

Shut off power at the main electrical distribution box.

Before moving the boom to a new location, verify that the receiving mast is properly anchored and braced.

Move the boom only in accordance with the manufacturer's recommendations.

Verify that the pipeline has been re-connected between the mast and the placing boom.

Inspect the bolts or pins holding the placing boom to the mast.

Using the manufacturer's recommendations, do a complete boom and tower inspection annually or whenever the boom has been subjected to damage or has been dropped.

Hard rock concrete weighs approximately 150 pounds per cubic foot. A five-inch standpipe will contain one cubic foot of concrete for every 88 inches (7.33 feet) of height. A five-inch diameter 10-foot pipe section will hold about 204.5 pounds of hard rock concrete.

The weight imposed at the bottom of a five-inch standpipe will equal 150 times height in feet divided by 7.33. EXAMPLE: At the base of a 200-foot tall five-inch standpipe, the weight of the concrete would be:

$$150 \times 200 \div 7.33 = 4,093 \text{ pounds}$$

The weight imposed at the bottom will change when using a standpipe other than five inches. If you are using a four-inch standpipe, use 11.46 instead of 7.33. If you are using six-inch standpipe, use 5.1 instead of 7.33.

EXAMPLE: At the base of a 200-foot tall six-inch standpipe, the weight of the concrete would be:

$$150 \times 200 \div 5.1 = 5,882 \text{ pounds}$$

The theoretical pressure (in PSI) exerted at the base of any standpipe will be equal to 1.1 times height in feet.

EXAMPLE: At the base of a 300-foot tall standpipe, the theoretical pressure should be: $1.1 \times 300 = 330 \text{ PSI}$.

VOLUMES: The volume of concrete you must remove from the placing boom after the pour is equal to the length of the boom in feet times .005, with the answer being cubic yards. This is assuming a 125mm or five-inch boom pipe system.

EXAMPLE: A 28-meter placing boom has a horizontal reach of 24 meters, which is about 78 feet $\times .005 = .39$ cubic yards (28-meter refers to the vertical reach). The vertical standpipe is figured in the total system in the pipeline volumes shown below.

The volume of concrete you must remove from a pipeline after the pour is approximately:

Five-inch line: one-half yard per 100 feet of line (.005 yards per foot) plus one yard for every 32 long-sweep elbows. (0.03 yards per elbow, (48-inch radius)).

Four-inch line: one-third yard per 100 feet of line (.0033 yards per foot) plus one yard for every 48 long-sweep elbows. (0.02 yards per elbow, (48-inch radius)).

Six-inch line: three-fourths yard per 100 feet of line (.0075 yards per foot) plus one yard for every 20 long-sweep elbows. (0.05 yards per elbow, (48-inch radius)).

The volume is not affected by whether the pipe is horizontal or vertical. You should make sure that whatever is receiving the concrete can accept as much as will be expelled.

EXAMPLE: When cleaning out a 28-meter separate placing boom connected to a five-inch pipeline 400 feet long with two long-sweep elbows, the concrete expelled will be:

$$.005 \times 78 = .39 \text{ plus } .005 \times 400 = 2 + .03 \times 2 = .06 \quad \text{Total} = 2.45 \text{ yards.}$$

The two sizes of pipeline normally used on placing booms are 125 mm (for booms built using metric standards), and five-inch (for booms built using SAE standards). It is critical the flange diameters of the pipeline are all the same, or an adapter must be used. DO NOT butt a 125 mm pipe flange to a five-inch pipe flange or vice-versa. Only a special clamp will safely join the two sizes, and it must be

properly installed. 125 mm pipe does not have the same inside diameter as five-inch pipe. The same flanges are welded to each size pipe, and they should not be used together as the size change will disrupt the concrete flow.

Depending on the brand of placing boom that you operate, you may encounter many different types of clamps. Either 125 mm snap clamps and 125 mm two-bolt clamps or five-inch snap clamps and five-inch two-bolt clamps; again depending under which set of standards the boom was built. In cases where the system will hang over workers (on the tip hose, for example), two-bolt clamps are safer than snap clamps.

A 28-meter or 32-meter separate placing boom without a counterweight weighs between 12,000 pounds and 18,000 pounds. The vertical load imposed on the floor, when in operation, is between 28,000 pounds and 30,000 pounds, which is the weight of the boom, pedestal, floor frames, concrete and pipe. Booms with counter weights are heavier. Always consult the manufacturer for exact weights and loads.

A CONCRETE PUMP/PLACING BOOM OPERATOR
IS RESPONSIBLE FOR THE SAFE OPERATION OF
THE PUMP AND BOOM.

FOURTEEN SAFETY HAND SIGNALS

1. Start pump – Speed up
2. Slow pump down
3. Stop pump
4. Little bit
5. Relieve pressure – 2 taps
6. Add water – 4 gallons
7. All done – Clean up
8. Boom up
9. Boom down
10. Boom left
11. Boom right
12. Open or extend boom
13. Close or retract boom
14. Stop boom

