

CHAPTER 6

TENDON STRESSING

6.1 General

The tensioning operation shall not begin until tests of concrete cylinders cured under job site conditions indicate that the concrete in the members has attained the minimum compressive strength specified for stressing in the project contract documents.

While the recommendations presented below are considered to reflect safe and generally accepted industry practices for stressing of tendons, the practices of individual companies may vary from these recommendations based on their experience. The specific recommendations of the post-tensioning supplier shall always govern over these recommendations in any instance where a conflict exists.

6.2 Preparation for Stressing

1. Edge forms should be removed as soon as possible to allow easier removal of the plastic pocket former and cleaning of the anchor cavity while concrete is still green. Other forms are left in place until after stressing.
2. Remove pocket former.
3. Clean out anchor cavity of the anchor. Remove any concrete slurry or foreign matter.
4. Check the integrity of the concrete, both inside the pocket and all the exposed surfaces. If cracks, voids, honeycombing or any other abnormalities are spotted, **DO NOT STRESS**. If honeycomb is suspected, sound out with a hammer and notify the appropriate parties.
5. Check that the tendon is perpendicular to the anchor and that the anchor is parallel to the face of the concrete (unless set at a different angle as per the plans). If either of these are out of alignment, notify the appropriate parties for instructions.
6. Remove excess P-T coating and any dirt, sand, or concrete slurry from the portion of the tendon tail where the initial mark is to be applied. It is very important to clean this area so that the mark does not rub off. This should be done as soon as possible after the edge forms are removed so that the marking material has time to dry before the stressing operation commences.
7. At an intermediate anchor where the P-T coating has been removed for marking purposes, reapply the P-T coating after stressing and restore the protection systems as per specifications.
8. Install the wedges evenly. Make sure the orientation of wedges is such that the seating plunger of the jack engages both (or all three) wedge sections.
9. Seat the wedges in position with a hand seating tool.
10. Mark the tendon tail with spray paint, whiteout or other means at a constant reference dimension

6. Ensure that the seating plunger is fully retracted. It should be approximately $\frac{5}{8}$ in. (16 mm) below the end of the nose-piece on most jacks. (This could vary with different brands of equipment.)
7. Start the pump and open the jack approximately 1 in. (25mm).
8. Open the jack grippers by pulling back on the gripper cable or handle.
9. Position the jack on the strand to be stressed and push forward until the jack nose bears on the anchor. Never attempt to adjust the position of the jack, either by striking or pushing after any load has been applied. Remove the jack and reposition it if necessary.
10. Push the jack grippers forward to engage the strand making sure that:
 - a. Jack grippers are parallel to avoid damage to themselves or the strand.
 - b. Strand is in proper position within jack grippers.
11. Place the pump 4-way valve in stressing position.
12. Operate the pump by use of the remote switch. (Use of the remote switch allows the operator to stand to the side of the pump, out of harm's way, should the tendon or the jack grippers fail).
13. The gauge should be facing the operator who is monitoring the gauge pressure. Reading the gauge from the side and at an angle will give faulty readings.
14. On pumps equipped with a sequence valve or automatic seating valve, (see Fig. 6-1)*:

**Other equipment configurations are available, consult specific equipment manufactures for proper instructions on operation.*

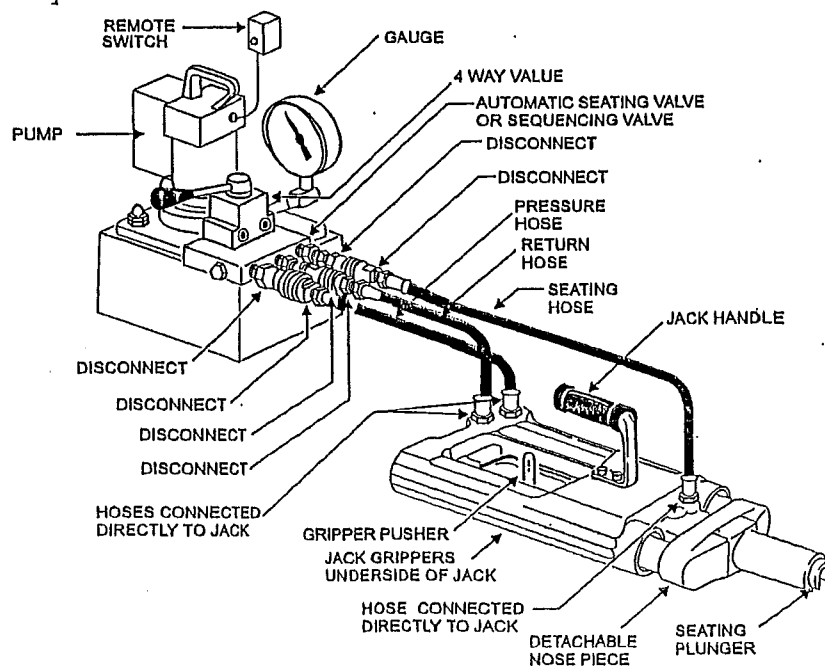


FIG. 6-1 Stressing Jack and Pump with Automatic Seating Valve

- c. Start pump motor (using the remote switch) and run until proper pressure is indicated on the pressure gauge.
 - d. Stop pump and immediately open the needle valve to the seating plunger (a small amount of pressure will bleed off the jack to feed the seating pistons).
 - e. Switch 4-way valve to retract position.
 - f. Run pump to return jack (this step is not necessary with a spring return jack).
 - g. When jack is fully retracted, stop pump, switch 4-way valve to stressing position and check seating plunger to make sure it has fully returned. Close needle valve to seating plunger. It is important to stop the pump and switch the valve quickly to avoid excessive pressure buildup in the jack after it has completely returned. This excessive pressure buildup can cause premature failure of the jack seals, hoses and fittings.
 - h. Slide the jack forward to release the jack grippers and remove jack.
16. If the calculated elongation is larger than the stroke of the jack, additional pulls will be required. Care should be taken not to over pressure the jack after the cylinder is completely extended. When using an 8 in. (200 mm) stroke jack, try to leave approximately 5 in. (125 mm) for the final pull. This will help to keep the pressures as low as possible on the anchor wedges during the initial strokes and avoid the strand slipping through its anchor wedges on the last pull.
17. Check the measured elongation:
- a. Determine the measured elongation by placing the initial marking device in its original position against the concrete and measure the distance that the initial mark on the tendon tail has moved away from the outer edge of the marking device. This measurement is the value reported for the tendon on the Stressing Record Form.
 - b. On double end stressing, always pull both ends to full gauge pressure, and add the elongation of each end together to obtain the total elongation.
18. The measured elongation tolerance should be within $\pm 7\%$ (or as specified) of the values shown on the approved installation drawings. Elongation measurements should be to an accuracy of $1/8$ in. (3 mm). If there are discrepancies consistently exceeding the tolerance, **DO NOT** stress any more tendons until the problem is identified and corrected (review item 19 below). A record of the gauge pressure, jacking force and the elongation measured must be kept for each tendon. A sample stressing record form is shown in Appendix 11.3. Submit complete stressing records to the Engineer of Record for approval at the earliest possible time and prior to the cutting of the tendon tails.
19. Causes of improper elongation:
- a. Poor marking procedure. When marking be sure to use a known reference point and make a clear and accurate mark on the strand.
 - b. Inaccurate measurements. Check your measuring device. Verify the end is not broken or bent. Verify original measurement.

- r. **Honeycombing.** Failure of honeycomb concrete behind or adjacent to an anchor may result in incorrect elongation measurement.
- s. **Incompatible anchorage components.** Check that the wedges and anchors are not from different post-tensioning systems.

20. Problems that can occur during stressing:

- a. **Jack will not extend or retract.** Check all hydraulic quick disconnects. If they are not connected properly or damaged, they will not pass fluid causing the jack to not move in or out. A good indication of this is the hoses are stiff, which indicates that pressure has built up but has no place to go. This can be determined by disconnecting the coupling and pressing against the ball, inside the coupling, with a finger. This ball should move freely. If it does not, simply release the pressure by slowly unscrewing the fitting. This will allow the fluid that is built up behind the fitting to escape. This fluid should not be allowed to drain onto exposed concrete surfaces. After releasing the pressure, retighten the fitting and connect the coupler.
- b. **The jack will extend but not retract.** Pressure can build up in the hoses when the pump is equipped with a sequence block, or automatic seating valve. This can be caused by the steel ball (in the sequence block or automatic seating valve) not being pushed off its seat by the piston. (Repairs in the field are not recommended.)
- c. **The jack extends or retracts slowly.**
 - 1. The power cord is not heavy enough. It must be a minimum of 12 gauge.
 - 2. The power cord is too long. It should be no longer than 100 ft. [30 m]
 - 3. Insufficient power at the job site.
 - 4. The jack seals on the four-way valve are bypassing. This can be tested by building pressure to 5000 lb. [22 kN] in the jack while it is fully extended, stop the pump and see if the pressure holds on the gauge. If the pressure does not hold, the equipment should be returned for repair.
 - 5. The pump could be low on oil.
 - 6. The filter in the pump may be dirty.
 - 7. The pistons in the pump may be worn.

6.4 Stressing Slab-on-Ground Tendons

Slab-on-ground stressing is much the same as other applications except that more care has to be taken:

- 1. Making sure that obstacles are removed from behind the jack. If the jack does not have a clear path to extend, some of the pressures generated in the jack will be expended in moving the obstacle and, therefore, result in short elongation.
- 2. Extra cleaning of the jack, jack grippers and strand must be done for slab-on-ground construction because of the proximity of dirt and sand while stressing. Dirt, sand and concrete slurry are very

10. If detensioning is necessary; it should only be done by qualified personnel (consult the post-tensioning supplier) using the proper equipment such as:
 - a. On a jack with removable nose-pieces, jack feet attached to the jack cylinders can be used if they sit firmly against solid concrete that is perpendicular to the jack.
 - b. A detensioning stool or stressing chair that sits firmly against solid concrete and is perpendicular to the jack.
 - c. A special detensioning nose-piece that sits firmly against the anchor.

11. If a jack gets "hung up" or should the anchor wedges fail, **NEVER UNDER ANY CIRCUMSTANCES** use a second jack on the back of the one that is "hung up" (piggy backing). In this situation, special equipment or procedures must be used such as:
 - a. A troubleshooting anchor can be used with most types of jacks.
 - b. A detensioning stool or chair can be used if it sits firmly against solid concrete and is perpendicular to the jack.
 - c. If accessible, the anchor at the far end may be detensioned.

Before any of these procedures are used, it is recommended that the post-tensioning supplier be contacted and the situation discussed before any action is taken.

12. If the concrete is visibly honeycombed or cracked, **DO NOT STRESS** until it has been properly repaired and inspected.

6.6 Don'ts of Stressing

1. **DON'T** stress any tendon which contain concrete slurry inside the anchor cavity. Concrete slurry in the anchor cavity will prevent proper seating of the wedges.
2. **DON'T** use the jack when it is not positioned properly on the face of the anchor.
3. **DON'T** overstress tendons in order to achieve proper elongation.
4. **DON'T** allow obstructions in the path of the jack extension.
5. **DON'T** use extension cords longer than 100 ft. (30m), 2 wire cords or cords less than 12 gauge.
6. **DON'T** continue stressing if you suspect that something is not working properly.
7. **DON'T** detension with loose plates, spacing shims or by 'piggy backing' of jacks.
8. **DON'T** stand in the immediate vicinity of the jack, or between the jack and pump during stressing or detensioning.