

## Introduction

FP McCann has prepared written safe procedures for the stressing operations taking place at all depots which must be strictly implemented. Roles of individuals involved in the process are defined in this policy document.

Only FP McCann trained and competent personnel are authorised in the operation of the stressing equipment. Adequate training must be provided to all operatives involved and assessments of competency carried out at the respective sites, which will be recorded within the FP McCann employee data base.

## Precautions during stressing operations

Personnel not directly involved in the stressing operation must be excluded from the work area. Warning Signs and an audible and visual (flashing light) alarm will alert personnel that stressing is about to take place/ or is taking place. Personnel who are not involved in the stressing operation must have vacated to a remote and safe location.

FP McCann will ensure that the stressing operator will adopt a system of work that ensures they are never directly behind the hydraulic jack. FP McCann operators will be provided with written instructions detailing the size of the strand or wire and the appropriate stressing force to be used. The instructions will also include the equivalent reading on the pressure gauge of the pump unit. This information will be recorded and records maintained.

A pre-determined load (preload) will be applied to all strand/wire to ensure that the barrels and wedges are seated correctly. The preloaded strand/wire will then be inspected over the length of the bed to ascertain that no strand/wire is crossed or snagged. Any issues found during the preload inspection will be rectified before the final load is applied.

The final load will then be applied to the strand/wire either by mass or by individual strand/wire tensioning techniques. Over-stressing is a common cause of failure; it is the operative's responsibility to ensure that over-stressing does not occur.

Upon completion of the stressing activities, the flashing light will be extinguished and the casting operatives will be permitted to return to the casting bed.

## Perform a risk assessment of the layout of the stressing area

Each factory will carry out a risk assessment of the stressing area to ensure that all the failure modes are considered, hazards are removed and protection is provided. This exercise may require modifications to be carried out, such as providing a minimum 75mm thick timber liner to absorb the impact of the failed end of the wire/strand. When the stressing operation is complete the jack-heads must be guarded. It is recommended that spring loaded grips are used at the anchorage/dead (non-stressing) end of the stressing bed.

Ideally, stressing should not take place until the last possible moment to reduce the amount of time stressed wire/strands are exposed in the working area. Unnecessary activity, around, over and above exposed stressed wires/strands should be avoided; such as walking or working on stressed beds/moulds and particularly lifting operations immediately above exposed stressed wires/strands.

Only one double-joiner per wire/strand is permitted. The maximum number of pulls on the wire/strand tails must be limited to ten pulls.

## FP McCann Do not's

**Do not** weld or carry out hot work operations on or anywhere near wire or strand. Heat will change the mechanical properties of strand/wire which may increase the possibility of premature failure. The damage caused by inadvertent heating will not be detected during a visual inspection.

**Do not** use an acetylene torch to cut to length or to trim steel wire before stressing, since the heat affected zone will extend several centimetres from the cut and the jack jaws may grip the mechanically weakened area. Only the use of snips or an abrasive wheel is permitted.

**Do not** remove any banding until such time that the coil has been correctly positioned within the dispenser.

**Do not** use hand held grinders to cut bands or packaging around full coils. Snips should be used to cut the banding on the coils.



**Do not** directly lift coils of wire/strand using lifting chains or other lifting devices with sharp edges.

Coils of wire/strand must be lifted using a webbing sling.



**Do not** allow the wire/strand to become tangled as it is pulled from the coil. In the case of strand ensure that it is pulled out in accordance with the instructions provided by the Supplier.

To prevent tangling of strand it is very important that the coils are loaded into the dispenser and pulled in the right way. The direction of pull will depend on whether the steel is LEFT or RIGHT hand lay; this is determined by the direction of strand winding. Suppliers should always identify the end of the strand and show the direction of pull on the label or test certificate, however if the direction is not shown, or has been lost it can be worked out using the rule of thumb.... If the steel is left hand lay, use your left hand and follow the direction the strand has been wound inside of the coil – your thumb will point in the direction of pull. If the steel is right hand lay, use your right hand and follow the direction the steel has been wound inside the coil – again your thumb will show the direction of pull.



#### Use of Safety Chains

Safety chains must be placed over the hollow core stressing beds at regular intervals (maximum 10 metres apart) to contain the wire/strand in the event of failure. The use of loosely bound polythene sheeting placed over the wire/strand can also assist in providing further protection. A daily visual inspection of the anchorage points for the safety chains should be completed by an authorised FP McCann operative.

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Where endplates are used, these can be considered as alternatives to the safety chains.

### Guarding

FP McCann will provide suitable and sufficient protection so that, in the event of wire/strand failure during stressing operations, the operator is safe. Guarding of the wires/strands after they are stressed can be achieved by using a box guard as illustrated in the picture below to cover the stressed wires/strands.



On single stressing beds, end guards are to be fitted with timbers so that any failed wires/ strands will strike and penetrate into them and absorb the kinetic energy. Once tendons are stressed, guards should be lowered over the ends of the wires which fully encapsulate the wire ends.

### Permanent Anchorage Points.

The permanent anchorage points at both ends of the stressing bed should be cleaned and examined at the prescribed frequency to ensure their integrity using a non-destructive testing (NDT) process e.g. ultrasonic, magnetic particle or dye penetrant by a trained NDT engineer. The NDT engineer should draw up an inspection schedule including the cleaning which is necessary to permit adequate examination. Records of the examination must be kept for 10 years.

### Hydraulic jacks

Routine inspection and maintenance of each hydraulic jack (as recommended by the manufacturer), including the jaws inside the jack, must be completed by an authorised person who has been appropriately trained. Jaws inside the jack must be replaced at intervals specified by the manufacturer.

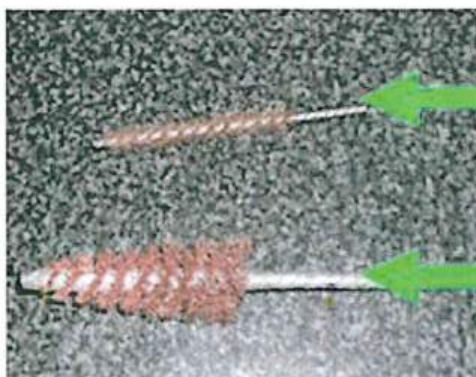
All hydraulic jacks must have a current calibration certificate. The calibration certificate is only valid where the same combination of jack and hydraulic pump are used. If the relief valve is not correctly set excessive tension may be applied to the wire/strand.

### Barrel and Wedge Maintenance

Barrels and wedges in poor condition may lead to slipping failure under load, and therefore should never be used.

**ALL BARRELS AND WEDGES MUST BE THOROUGHLY CLEANED, EXAMINED and LUBRICATED AFTER EACH USE.**

Manufacturers can make recommendations for appropriate cleaning methods. Depending on the cleaning system the barrels and wedges must be lubricated using the appropriate material.



Wedge Cleaning Brush

Barrel Cleaning Brush

### Inspection

The inspection of wedges and barrels should be carried out in an area away from the production environment. Where possible the inspections should be carried out by a person not involved in the

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production process. Inspection of the wedges and barrels must be carried out in good light. Rejected items must be identified and removed from the production process immediately. An independent inspection of the stressing equipment shall be carried out by a third party every 12 months. Management at each FP McCann location will carry out spot checks on the implementation of the safe operating procedures. Records of these inspections will be maintained.

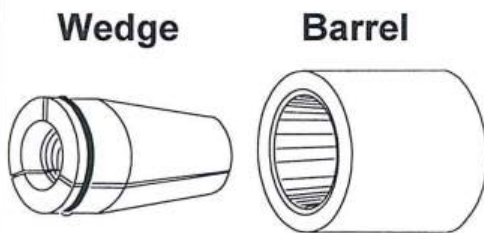
### Barrels and Wedges

Manufacturers of wedges should mark them with the wire/strand size and the barrels should be marked with a maximum load capacity and traceability code. This **is not** the site stressing load and reference to the sites design engineers should be used to determine the required load.

Wire/strand restraints come in three versions

- Open Wedges
- Enclosed (spring loaded) Wedges
- Strand Joiners (Double Ended Joints)
- Button heading

### Open Barrel and Wedge



These are the most common in use at the live end with a jack which has a secondary function to "lock off" the wedge with a small piston at the end of

the jack. It can however be used at the dead-end also. When used at the dead-end care is necessary to ensure that the wedge is "locked off" by tapping the wedge into the barrel.

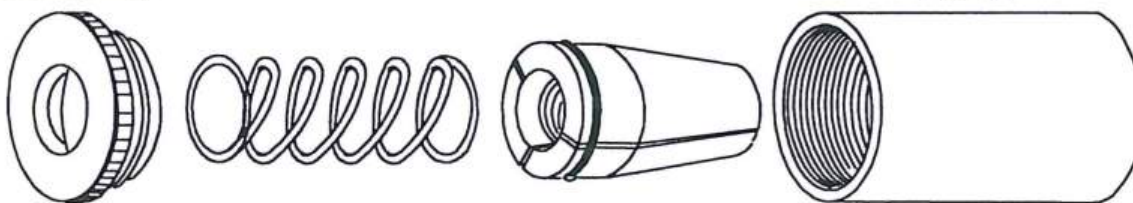
"O" rings or circlips are important to ensure alignment of the segments and should be regularly changed.

#### Advantages are:

- Ease of cleaning and maintenance.
- The wedge can be inspected during use.
- Low component count.

### Enclosed Barrel and Wedge

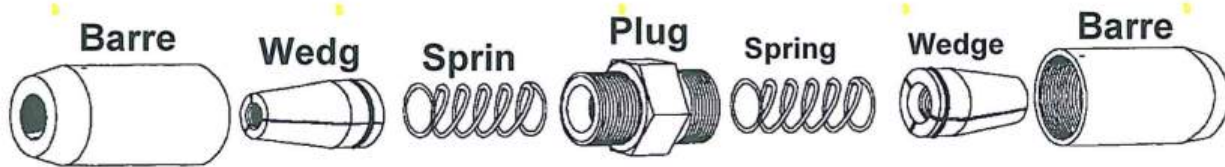
#### Screwed Cap



The spring loaded grip should normally be used at the non-stressing end of a bed, but when pre-stressing is carried out using a jack without power lock-off, they may be used with care at the stressing end of the bed. It should be noted that when used in this way the "lock off" loss may be high. If multi-stressing it is recommended that spring loaded grips are used at both ends of the stressing bed.

The condition of the spring is vital to ensure safe use of SLA's and DEJ's and should be changed regularly especially when they are damaged by "shock de-tensioning".

## Wire/Strand Coupler

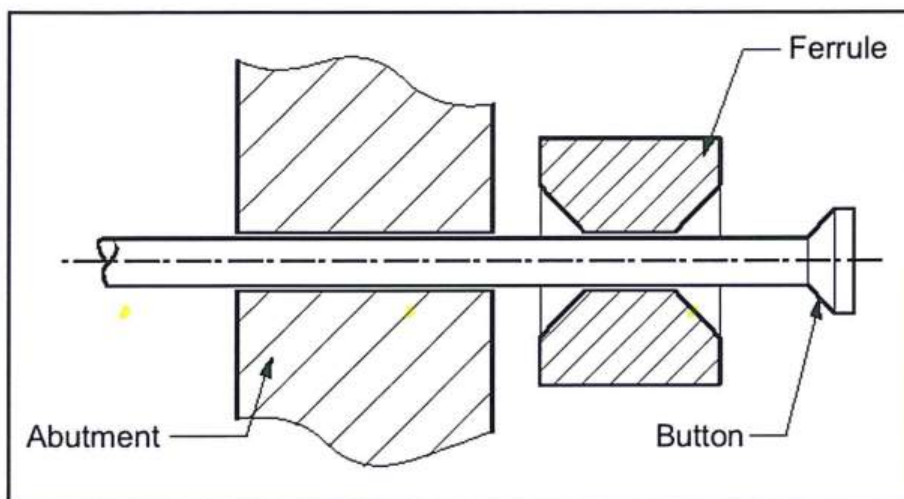


They are used to connect two lengths of wire/strand. This enables savings in wastage's, as the wire/strand may be re-used when the pre-stressing bed is only partially filled. The large hexagon or knurled centre plug promotes easy assembly.

Note that this type of anchor should be used with care as the end of the strand is enclosed in the wedge. As a result it is difficult to ensure that the strand has been fully inserted and to monitor any slip of the strand in the anchor. A safe working system should ensure that the strand is marked so that when the strand has been fully inserted a mark is visible and will confirm that the anchor is performing correctly.

## Button Heading

Button heading can be used instead of barrels and wedges on wire systems. The wires are cut to a precise length and a hardened steel ferrule is positioned prior to upsetting the end of the wire (buttoning)

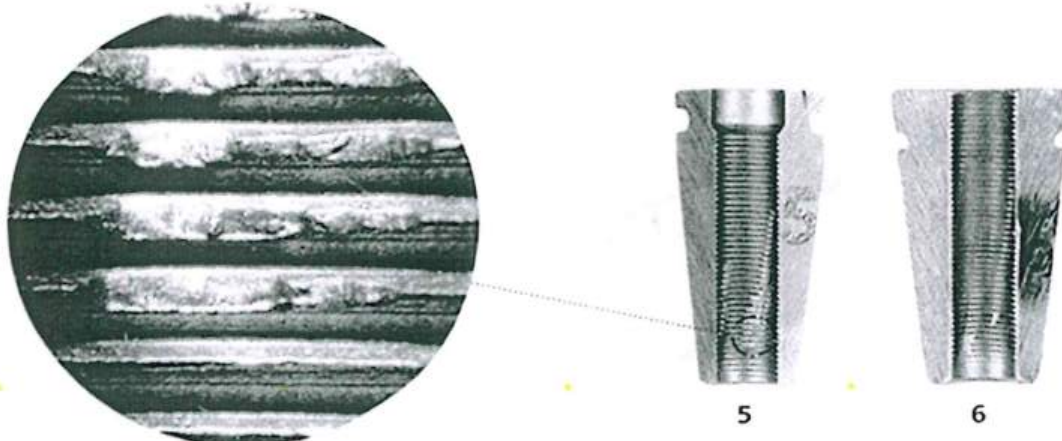


Button Heading

Samples of the Button Heading process shall be tested daily to confirm the tension at failure.

## Guidance for Inspecting Wedges and Barrels.

Below is an example of wedges where the teeth are damaged. The strand has slipped causing a gouge diagonally across the teeth. These wedges must be replaced.



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When inspecting the wedges look for worn/damaged teeth, i.e. the points of the teeth have been flattened beyond a tolerance which is specified by the manufacturer. For example one such specification identifies 0.2 - 0.3mm for the maximum width of the flat on the top of the tooth where the pitch (distance between the teeth) is 1mm. This tolerance is not applicable to all wedges – always check with the manufacturer.

Identifying flattened teeth is important for two reasons. Firstly the teeth are intended to bite into the wire to achieve a grip; flattening of the teeth reduces the effectiveness of the grip. Secondly, the teeth are case hardened to improve the wear resistance of the wedge grip. With use, the hardened case gradually wears and when it is worn through, the softer core will be exposed to the wire and may wear more quickly. Any wedges that are showing signs of significant wear must be taken out of service. Wedges found to have broken or damaged teeth and/or any cracks shall be identified and discarded immediately. Barrels should also be examined for signs of wear, cracks or distortion especially in the inner taper. Operators should only use wedges and barrels in good condition. Any suspect wedges or barrels should be identified and either segregated in quarantine awaiting further examination or discarded straight away.

#### **Use of a Rotation System for Barrels and Wedges**

Sufficient quantities of barrels and wedges shall be used at each location to ensure a set is available to be utilised in production and a set is being maintained/inspected simultaneously.

**Barrel and wedges must be used in sets provided by the same manufacturer and must not be mixed.**

#### **Personal Protective Equipment**

It is the responsibility of each individual operative to ensure that the correct PPE, as specified in the Risk Assessment, is worn at all times during stressing operations.

As a minimum the following equipment must be worn:

- Hi-Visibility overalls
- Hard hat
- Safety boots
- Safety glasses
- Gloves (type as specified in the Risk Assessment)

**REMEMBER: IF THERE IS ANY DOUBT CONCERNING ANY OF THE STRESSING EQUIPMENT, DO NOT USE IT.**

Signed: \_\_\_\_\_

**Hugh McCann**  
Managing Director

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