

29T. Landing gear - trigear

Main landing gear

Introduction

The main landing gear comprises two separate tapered steel legs which are fixed within mounting tubes. The mounting tubes are each bonded into the bottom of the baggage bay, and supported with four plywood and fibreglass ribs. See figure 1 at the end of this chapter.

Integral with each main leg is the axle for the 5.00 x 5 size wheel. A torque plate for the disc brake caliper mounts onto the axle and is held in place by a bolt.

The axles are arranged so that the wheels are parallel when there is no weight on the landing gear; a small amount of toe-in results when the gear legs bend under load.

The main gear leg enters the fuselage in the bottom of the baggage bay just aft of the front bulkhead, and angles back and up to end not above the height of the central tunnel. To take out the loads imposed by the main gear, the lower portion of the baggage bay requires reinforcing.

Reinforcement of baggage bay

The top of the leg is mounted within a flanged tube which is bonded at its base to the fuselage side. This tube is then supported by four ribs running to all four corners of each baggage bay section.

Mark the position for the holes in the fuselage for the landing gear mounting tubes on both sides, and using a 40 mm (1 1/2") diameter hole saw, cut through the fuselage skin. See figure 2.

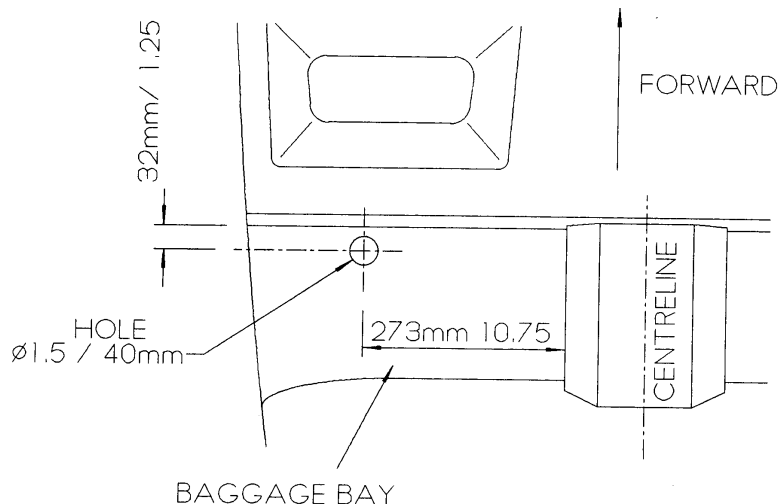


Fig 2. Plan view of baggage bay.



Leaving the outside skin intact, cut away any of the accessible 3 mm foam core which is within 4 cm (1 ½”) of the hole’s edge, and chamfer the edge to make a gradual transition from inner to outer skin. Scuff sand the whole area of the baggage bay up to the level of the top of the central tunnel.

Lay up 2 plies of ‘bid’ at +/- 45° over the entire area of the baggage bay up to the level of the top of the central tunnel. Flox fill any areas as required to avoid air bubbles.

Next add 2 plies of ‘uni’, to the same height, onto the baggage bay rear bulkhead from the sidewall to the central tunnel, with the fibres running spanwise. Also lay up 2 plies of ‘bid’ at +/- 45°, 20 cm (8”) wide, running fore and aft, centred on the hole, and lapping onto both the forward and rear bulkheads by 10 cm (4”). Cover the ends or even the whole area with peel ply and allow to cure.

Scuff sand the outer skin to a diameter of 25 cm (10”), and lay up 1 ply of ‘bid’ at +/- 45° to the aircraft longitudinal axis. Peel ply all over, and allow to cure. After cure, recut the 40 mm (1 ½”) diameter holes.

It will be necessary to elongate the two holes cut in the fuselage bottom to allow the tubes to be set in at an angle. Do this during the trial installation.

Gear leg installation

Setting up

Mark a centre line on the workshop floor the length of the fuselage. On the fuselage underside, along the centre line, a series of crosses are moulded in. These may be faint and will require highlighting with a soft pencil. They are spaced at 10” intervals, the one nearest the firewall indicates Fuselage Station 30 (FS 30). Using two of these crosses, spaced as far apart as possible, drop a plumb bob from their centres to position the fuselage centreline directly over the centreline marked on the floor.

The aircraft must also be set level in both pitch and roll axes (use your spirit level on the port side door sill and the tailplane torque tube) with the fuselage bottom 413 mm (16.25”) above the floor, measured at the centreline between the main gear holes. If, when carrying out the trial installation which follows, you have difficulty in achieving the dimensions shown in figure 3, it is acceptable to change the fuselage height - it may need to be higher by up to 19mm (3/4”). This is a result of the build tolerances.

Once this is achieved, mark the fuselage station that the front plumb bob indicates, and from this reference point mark FS70 at the centreline. Now accurately mark a line at 90° to the centreline at FS70 to be about 1m (40”) long each side. This line represents the main gear axle centreline. Check that your workshop floor is level along this line.

To aid holding the main gear in position during setting up, a 2m (6’ 2”) long rigid straight edge will be required, such as angle iron. Whatever you use, make sure that it is straight.

Trial installation

Carry out the following to check that everything fits as desired, and to understand the installation procedure.

Insert the main gear sockets (MG03P and S) into the holes in the baggage bay floor from the outside and then slide in the main gear legs themselves.

Note: *The sockets are handed port and starboard, but the legs are identical.*

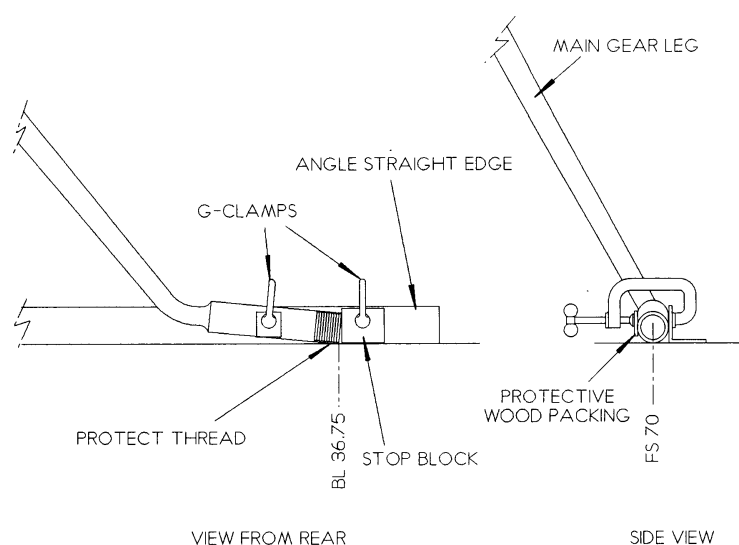
Insert an AN5-21A bolt through the ends of the socket and the leg, then arrange the axles so that their centrelines are directly over your FS70 line on the floor. The ends of the axles should be 36.75" from the fuselage centreline (BL 36.75) where they touch the floor.

Note: *Protect the threads of the axles from damage by using some tape, but don't run the tape all around the ends, as this will alter the axle alignment if it gets between the axles and the straight edge.*

The positive camber angle of the axle is intended.

To stop the natural tendency of the gear legs to slide out of the fuselage, clamp the axles to your straight edge to hold them together.

If necessary, to ensure that the plate of the gear leg socket is against the side of the fuselage, move the axles as required relative to the fuselage centreline keeping the axle centres on FS70. It may also be necessary to alter the shape of the plate slightly so that they follow the fuselage contour better. A precise fit is not required. When you are satisfied with the positioning of the gear legs clamp a block of wood to the straight edge so that it rests against the end of the axle, and fix the straight edge to the floor with Bondo. This will enable easier setting up when bonding the socket into the fuselage. See figure 3.



Note: *FS70 is 2.25" aft of the forward face of the port spar, and 1" aft of the forward face of the starboard spar.*

Fig 3. Jig to set gear leg position.



Bonding socket tubes

With the jig secure, remove the landing gear legs and the sockets from the fuselage, and prepare for bonding the sockets permanently into place.

Scuff sand the fuselage side externally and drill several 6 mm (1/4") holes through the socket plate, no closer to each other or the tube than 15 mm (5/8"), to provide a good key for the adhesive. Dimple the outside of the tubes with a smaller drill (don't go through) every 3 - 4 cm (1 1/2") or so, thus providing a key to the ribs which will be added later.

Re-insert the sockets and the landing gear legs, leaving them not quite in position, to allow adhesive to be applied behind the plates. Mask the legs so that dripping or running epoxy will not get up between the legs and the socket tubes.

Don't expect gravity to prevent the epoxy going up the tube, as capillary action will make sure that it does if it's allowed to!

Mix up a small quantity of Araldite 420 and add flox to stop it slumping, then coat the inside surface of the socket plates. Carefully move the axles into their correct positions, clamping them in place, and double check that everything is in its correct position.

Scrape away the excess adhesive, then cover with peel ply and leave everything untouched until fully cured.

Socket tube ribs

The ribs are made from 19 mm (3/4") marine plywood, and laid up with glassfibre. The sequence in which they are to be installed is shown in figure 4, but it is possible that ribs 3 and 4 may be able to be installed in one operation. The first rib must be installed on its own as its layup wraps around the socket tube. Leave the landing gear leg jiggged up until after this rib has been bonded in place.

Make plywood ribs to fit between the tube and corners of the baggage bay. Templates may be found in Annex F from which you should make cardboard ribs first, which you can adjust to fit your aircraft before cutting any wood. Ribs 1 and 2 butt up against the tube, while ribs 3 and 4 will only contact part of the tube, as the tube is at an angle to them. The tops of the ribs should remain slightly below the top of the central tunnel in the baggage bay.

Try to make the ribs fit with a gap of no more than approximately 1.5 mm (1/16") at their contacting edges. There's no need to be too precise as you need a gap for adhesive to get into, and you shouldn't have to wedge the ribs in place as this may move the socket slightly.

Installation

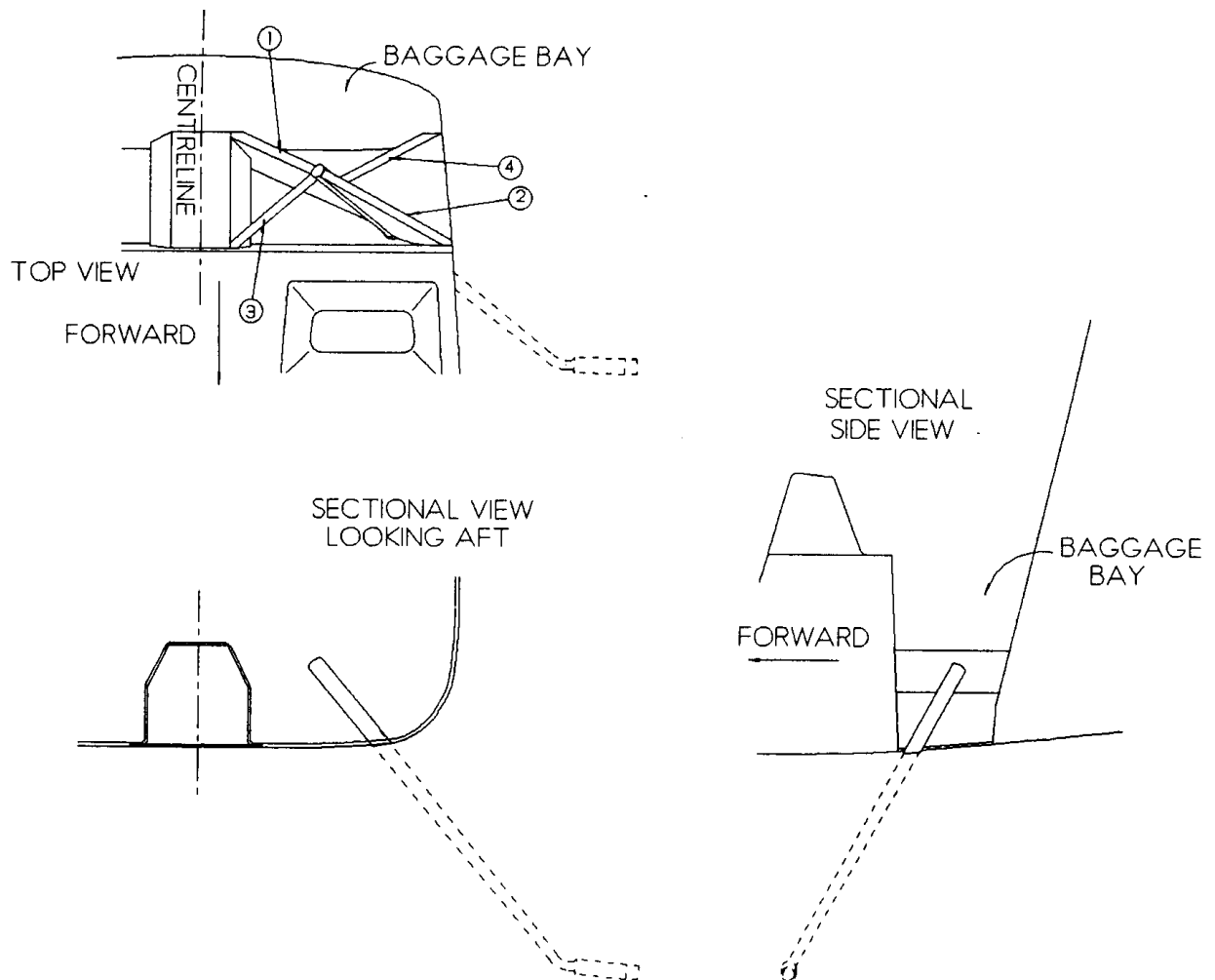


Fig 4. Detail of socket tube and rib installation.

Step 1

Scuff sand the tube all around, and the bonding areas inside the baggage bay if they have not been peel plied. Install rib 1 with Araldite 420 and flox, central to the tube and fitting into the inboard rear corner of the baggage bay area. Peel ply the flox and allow it to cure; this will give the socket tube more rigidity so that it is less likely to be disturbed during the rib installation process. Remove the landing gear legs as a precaution to prevent them becoming bonded into their sockets.



Step 2

Remove the peel ply, then fill any gaps and blend the tube to the rib with a stiff mix of Araldite 420 and flox, then immediately lay up 3 plies of 'bid' onto one side, oriented at $\pm 45^\circ$ to the rib top edge, wrapping them around the tube and back onto the other side of the rib about 75 mm (3"). Stagger the ends of the plies so that they are shorter by 1 cm ($\frac{1}{2}$ ") each ply. Lap the plies onto the floor and vertical sides of the baggage bay by 25 mm (1").

Now lay up 3 similar plies on the second side, wrapping them around the tube and onto the other side back 75 mm (3") as before. Peel ply the top 50 mm (2") all along for a later lay-up to be added.

It's not impossible to add the second rib before the first has cured in place, but it may be wise to allow it to cure undisturbed.

Step 3

Install rib 2 with Araldite 420/flox and 3 plies of 'bid' each side as you did rib 1. Overlap the plies onto rib 1 by 50 mm (2"), staggering the plies back 12 mm ($\frac{1}{2}$ ") each ply. Again peel ply the top 50 mm (2") all along.

Step 4

Install ribs 3 and 4 with Araldite 420/flox in a similar manner to the previous ribs, laying up 3 plies of 'bid' at $\pm 45^\circ$ on each side, lapping onto ribs 1 and 2 by 50 mm (2") staggering the plies, and onto the floor and vertical surfaces by 25 mm (1"). Again peel ply the top 50 mm (2").

Remove the peel ply and round off the top edges of the ribs to a radius of approximately 6 mm ($\frac{1}{4}$ ") for the glassfibre to go around .

Lay up 3 plies of 'uni' over the top of the ribs and down each side 25 mm (1"), with the fibres orientated along the ribs. Lap the plies onto the baggage bay by 25 mm (1").

Socket outer lay-up

Lay up 2 plies of 'bid' at $\pm 45^\circ$ over the socket plate, lapping them onto the outside skin 65 mm and 50 mm ($2\frac{1}{2}$ " and 2"), staggered, beyond the flange edge. Peel ply the entire layup and allow to cure before cutting away the glassfibre over the socket opening.

Gear leg installation

Open up the $\frac{5}{16}$ " diameter hole in the top of the socket tube and install the gear leg with an AN5-21A bolt, MS21042-5 stiffnut and an AN960-516 washer each side, bonding the washer to the glassfibre with Araldite 420 and flox.



Wheels and brakes

Brake caliper and torque plate

The brake caliper supplied has a universal torque plate installed with it which is not required, and is to be substituted by the axle mounted torque plate MG02.

There are two lugs on MG02 which are intended for the attachment of a bracket to support a wheel fairing (not supplied as part of the standard kit). Remove the two bolts attaching the torque plate to the caliper assembly and slide off the torque plate; replace it with the torque plate MG02. Orientate MG02 so that the large diameter tube is on the fixed brake pad side of the assembly.

Tighten the bolts and nuts and wirelock the two bolts without nuts.

Torque plate to axle

Slide the torque plate / caliper assembly onto the main gear axle so that the caliper is uppermost and the chamfered end of the tube is outboard. Choose the caliper which will position the bleed nipple forward; however this is not vitally important as it can simply be removed and screwed into the hole on the opposite side of the cylinder.

Align the holes of the axle and torque plate tube and install an AN5-16A bolt, securing it with an MS21042-5 nut. You can screw the elbow fitting MSC269P into the hole opposite the bleed nipple, which will save you looking for it later on.

Tyre and inner tube

To install the tyre and inner tube remove the wheel cover, then remove the three bolts holding the wheel halves together and split the wheel. Put the inner tube into the tyre and partially inflate it to help prevent it from becoming trapped when putting the two wheel halves together again. A strip of thin cardboard wrapped around the wheel to keep the inner tube away from the joint as the two wheel halves are clamped together may be found to be helpful.

Warning: *Do not attempt to inflate the tyre until **all** the bolts are correctly tightened (1.15 kgf.m, 11.3 N.m, 100 lbf.in). Deflate the tyre completely before slackening the nuts to split the wheel halves.*

Locate the inflation valve in the cut out of the outer wheel half then join the two wheel halves together. Replace the three bolts and tighten them before inflating the tyre to 2 bar (30 psi).

Note: *Fully deflate the tyre before removing the three bolts holding the wheel halves together.*

Main wheel and brake disc

To install the wheel it is necessary to remove the brake disc first and re-attach it whilst it is between the brake pads. Note that the counterbored side of the three fixing holes should be inboard.



Insert the wheel bearings into the wheel hubs and (having cleaned and lubricated the axle and bearings with grease) slide the wheel onto the axle until the inner bearing butts up against the torque plate tube.

Note: *It may necessary to rub down the axle with fine emery paper to allow a sliding fit.*

Before attaching the brake disc to the wheel, screw on and tighten the axle nut with its washer, AN960-2016, to a torque of 17 Nm (1.725 kgf.m, 150 lbf. in), to seat the bearings properly and to determine the position for the split pin hole in the end of the axle.

Drill the 1/8" hole as close to the vertical as the castellations of the axle nut will allow. The leg has been hardened so use a new drill.

Having drilled the split pin hole, removal of the nut should take off any burrs on the thread, but be careful that the swarf doesn't jam the nut.

Re-torque the nut and install the EUR031 split pin to secure it and replace the wheel cover.

Bolt the brake disc to the wheel, torque tightening to 4.5 N.m (0.46 Kgf.m, 40lbf.in), and wire lock each bolt to the disc.

Nose gear

Introduction

The nose gear is a castoring fork type with the same size wheel as the main gear, and is fitted with a low drag 11 x 4.00 tube and tyre, inflated to 2 bar (30 p.s.i.).

The castoring fork is prevented from shimmying by means of a simple friction type shimmy damper which is adjustable with a nut.

A tubular steel spring, onto which is mounted the nose wheel fork, provides the suspension for normal operations. The steel tube is bonded and bolted into a tubular steel structure which attaches to the landing gear socket frame with half bearings.

Supporting the nose gear in normal operations is a bungee. Greater than normal loads on the nose gear result in the whole assembly pivoting about the lower member of the landing gear frame, and stretching the bungee.

A safety cable is attached to the bungee mountings to limit the total movement of the leg, and to prevent total collapse of the nose gear in the event of the bungee breaking.

Assembly

The main leg of the nose wheel is supplied already installed into the nose gear main fitting, and is ready for installation onto the nose gear landing frame. The assembly is oiled for corrosion protection during factory storage and delivery so, before painting, thoroughly degrease everything.

The half shell bearings are in matched pairs so keep them together and in the orientation that you receive them. There are dot markings on them to help identification.

Installation

Remove the four bearing retaining bolts and drill the heads for lock wire.

Assemble the nose gear to the lower member of the nose gear frame, noting that the half shell bearings locate against guides welded to the frame.

The bearing bolts should be tightened to 130 - 150 lb. in. torque. Check that, as the bolts are tightened, the bearings do not grip the frame. If the bearings are too tight, remove material from the bearings only, then install them with grease.

After tightening the bolts, secure them with safety lock-wire. A reminder of typical locking is shown in figure 5.



Fig 5. Typical wire locking detail

Wheel fork assembly

The nose-wheel fork is supplied with the pivot shaft already installed and secured with a pin.

A plastic disc NG05 is to be placed over the fork's shaft and prevented from rotating relative to the fork by means of a short pin NG08. This disc is the friction plate of the shimmy damper. Press the pin into the top surface of the fork and check that its end is at least 1 mm (0.04") below the surface of the plastic disc.

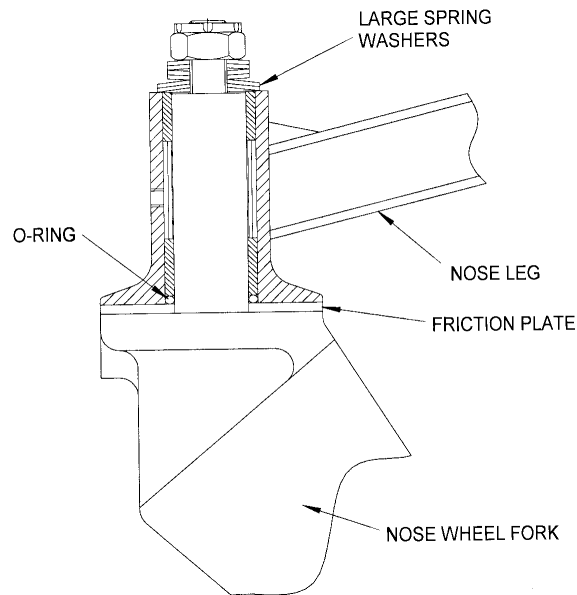


Fig 6. Arrangement of nose-gear housing and fork assembly.

Fit the O-ring BS214 into the bottom of the housing as shown in figure 6.

Ensuring that the pivot shaft and the bore of the nose gear leg are clean, apply some grease and insert the shaft into the housing.

Screw a grease nipple EUR038 into the front of the housing.

Spring washers, arranged in the sequence and orientation shown in figure 7, are next to be placed over the shaft, followed by the castellated nut.

Pump grease into the housing until it oozes of the top

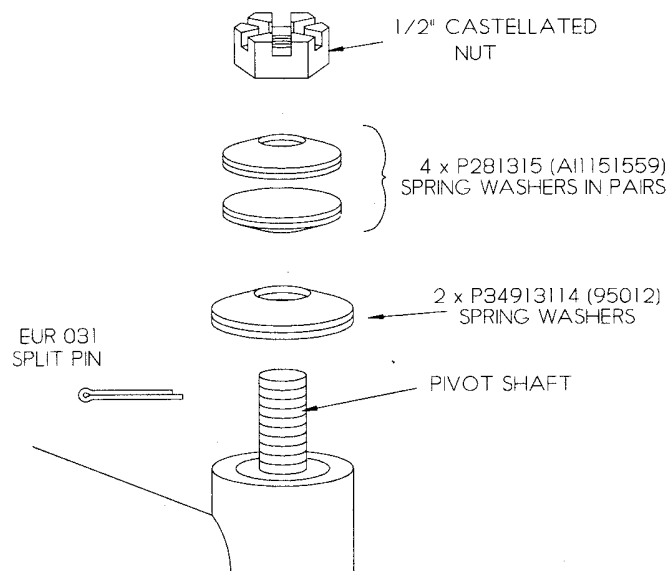


Fig 7. Arrangement of spring washers.



Nose wheel installation

The nose wheel is the same design as the main wheel (without the brake), and is assembled in the same way with a few exceptions (refer to Page 29T-17). Unlike the main gear, the nose gear bearings inner races are bonded to the axle to provide proper operation of the bearings.

Assemble as follows:

Pack the bearings with grease and wipe the inner surfaces dry. Apply a light film of grease on to the outer diameter of the bearing rubber seals.

Then, thoroughly degrease the inner races of the wheel bearings and the areas where they contact the axle.

Fit the bearing outer races, if not installed, into the hub. Be sure to seat them fully. Apply a thin film of grease to the race and the seal contact area of the wheel hub.

The next step is to ensure the inner bearing race of the wheel bearing is properly fixed to the axle shaft NG 06. Apply a thin film of Loctite 638 to the axle. Install the bearing with the rubber seal against the large diameter stop on the non threaded end of the axle. Slide the axle and bearing into the wheel hub. Apply a thin film of Loctite 638 to the axle's other bearing contact point so that the inner half of the other bearing race will be bonded to the axle shaft NG 06 as well. Fit the EUR014 washer and the large axle nut NG09 and tighten it sufficiently to ensure that the inner races are pushed fully home. Leave to cure for 15 minutes at room temperature.

Holding the axle NG06 in a vice, slacken off the nut and apply Loctite 638 to the exposed thread. Now tighten the nut whilst rotating the wheel back and forth until it is possible to rotate the wheel without the rubber seals of the bearing outer races moving. Allow the Loctite to cure for 15 minutes. Full strength of the Loctite is available in 12 hours.

Note that there will be some drag caused by the outer diameter of the rubber seal rubbing on the wheel - this stiffness is normal, and will reduce with time as the seals wear in.

Now slide the whole assembly into the fork with the large diameter on the port side, and insert the 12mm axle bolt and M12 washer. Fit the other M12 washer and the M12 Nyloc nut and tighten it so that the fork is compressed onto the ends of the axle."

To set the shimmy damper stiffness a spring balance, or other suitable device, which is capable of registering loads of up to 10 Kg, is required. With the nose wheel clear of the ground a load of between 8 and 9 Kg (18 - 20 lb) should be required, as measured at the back of the nose wheel tyre, (not the axle), to overcome the friction force produced by the shimmy damper. Adjust the nut to obtain the correct damping friction then install the split pin. This setting should be checked regularly; you will soon become used to what feels too tight or too loose.

Warning: *Failure to maintain adequate shimmy damping could result in component failure.*



Bump stop rubber

Cut a 75mm (3") length of the 1" diameter bump stop hose provided, slit it lengthways, open it out and fit it around the lower part of the large diameter tube in the nose gear mounting frame. Hold it in place with a couple of tyrap. This acts as a cushion between the frame and the nose gear for when overloads stretch the bungee.

Bungee and safety cable

Before the nose gear leg will take the weight of the aircraft a bungee cord must tie the tee end of the leg to the large diameter tube at the back of the nose gear frame. Before installing the bungee, however, the safety cable should be added to the same anchor points such that it will allow the nose gear leg to pivot only enough that the bump stop can move 5 cm (2").

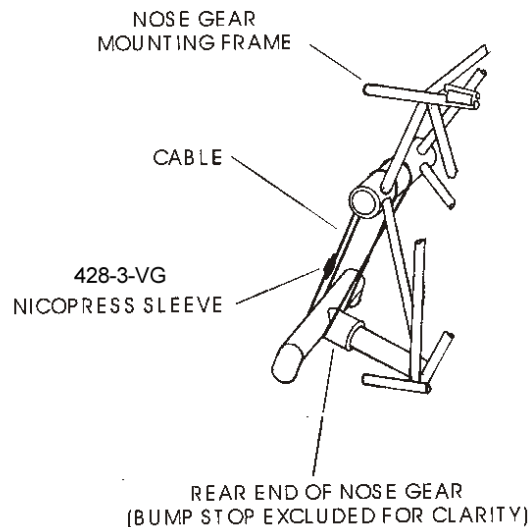


Fig 8. Routing of safety cable.

Safety cable

Cut a 150 cm (60") length of the 2.5 mm steel cable and run it round the large diameter tube of the nose gear frame and the tee end of the nose gear leg, then back over the nose gear frame tube before running it back down to go around the other side of the main shaft. Pivot the nose gear leg so that there is a 5 cm (2") gap between the end of the bump stop and the nose gear frame, then swage a 428-3-VG Nicopress sleeve to hold the two ends of the cable together. See figure 8.

Bungee

Tie one end of the bungee cord to the bottom horizontal tube of the nose gear frame with a double half hitch knot, with the end secured by a ty-wrap, and route it according to the photos in figure 9. The routing is back from the start tube, under the t-bar at the base of the nose gear leg assembly, over the top horizontal tube of the nose gear mounting frame, then 2 more turns around those tubes. The bungee then passes underneath the nose gear leg and across to the other side. The same routing applies on the second side, finishing off with another double half hitch knot.

You may find it easier to mark the centre of the length of bungee cord and start from the centre where the bungee passes underneath the nose gear leg. The tensioning can be made easier by using a wooden wedge between the top bar and the firewall to hold the bungee while tightening further.

Progressively tighten the bungee until it is stretched to about 175% of its original length. When the bungee is correctly stretched, a load of at least 150 Kg will be required to move the nose gear leg off the bump stop.

Note: *As a guide, the distance between successive blue stripes will be about 25 mm (1").*

Remember that the bungee does not provide the nose gear springing, the flexibility of the leg does this. The bungee is to allow a momentary overload to take place without over-stressing the anchor point.

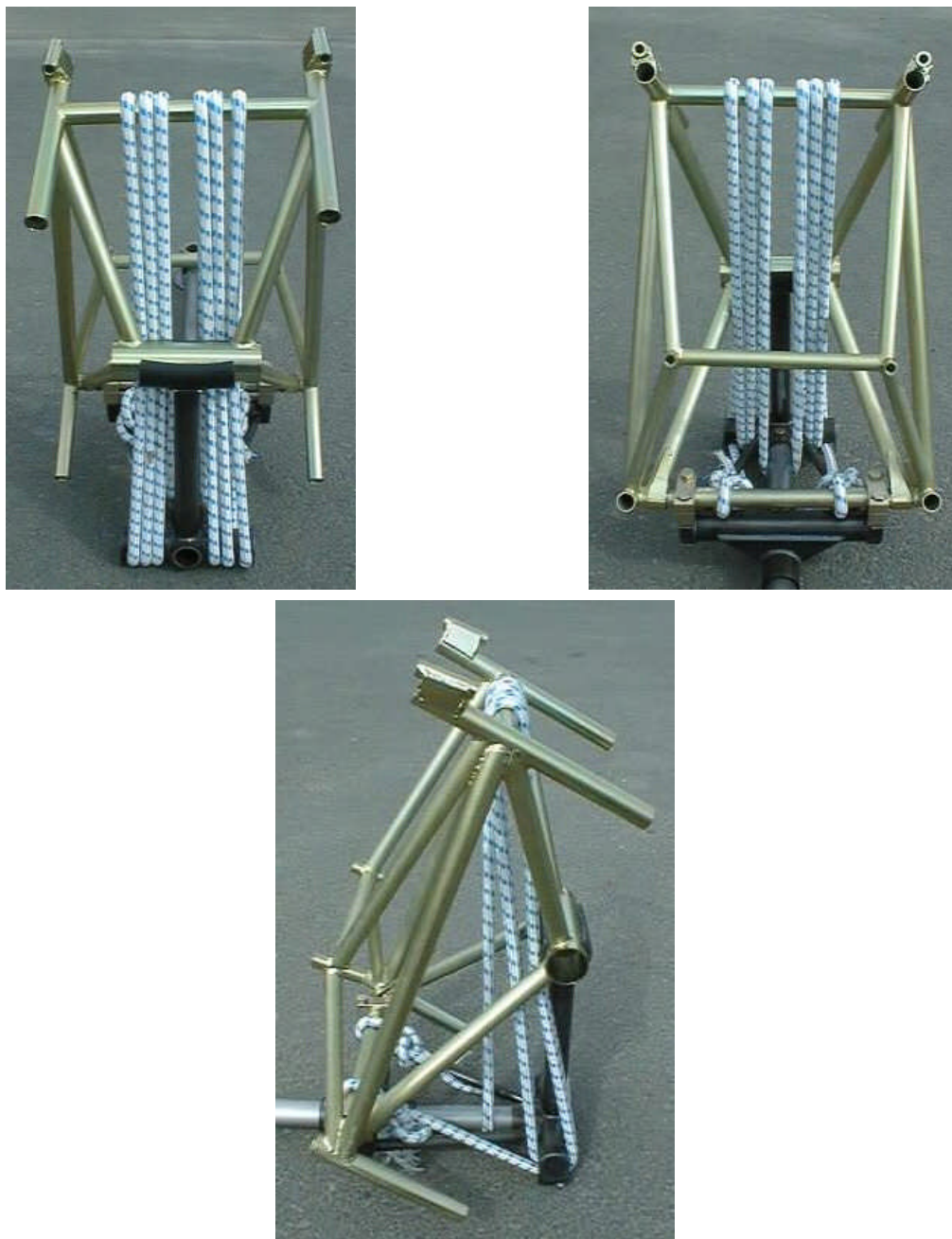
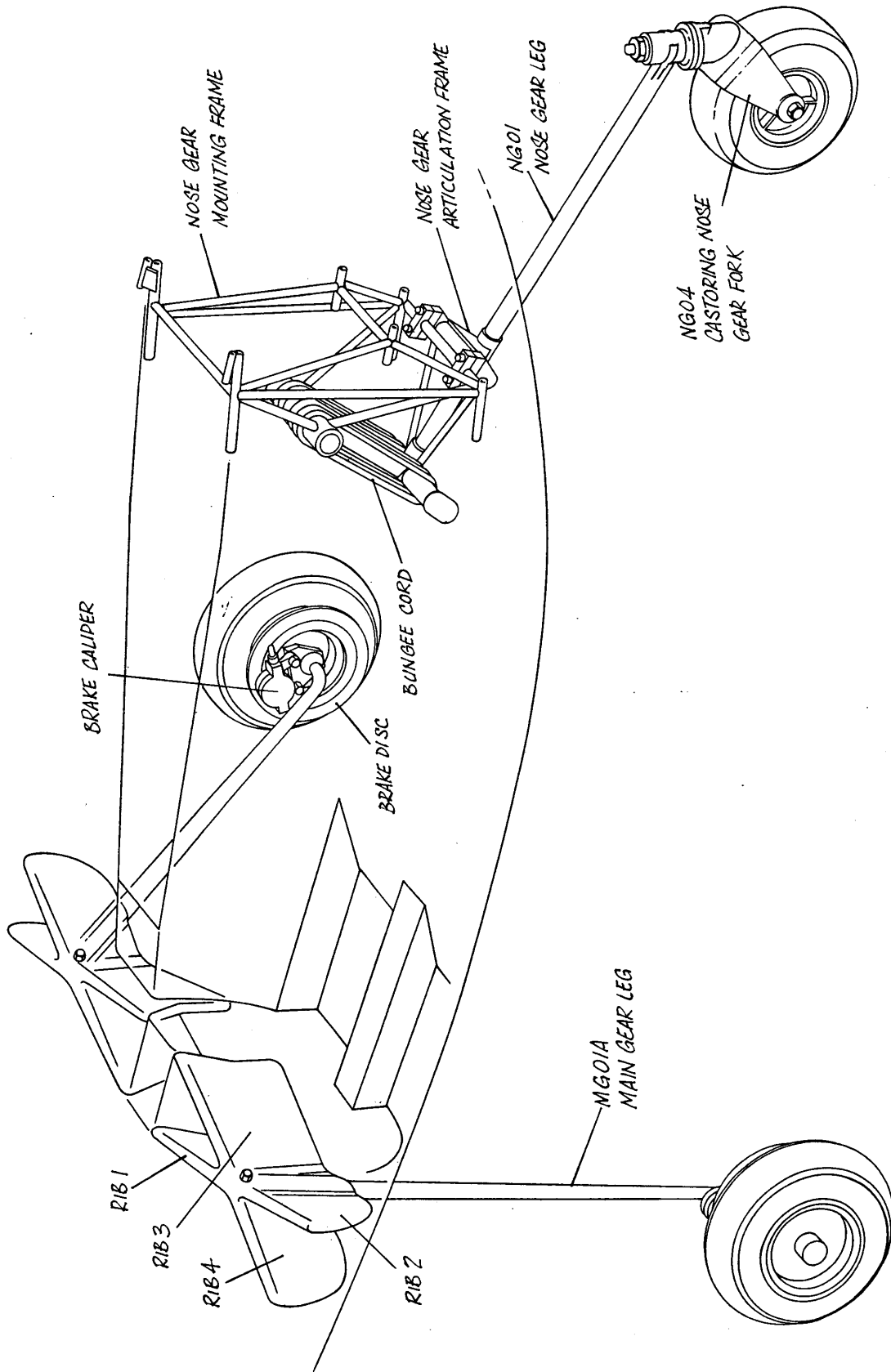
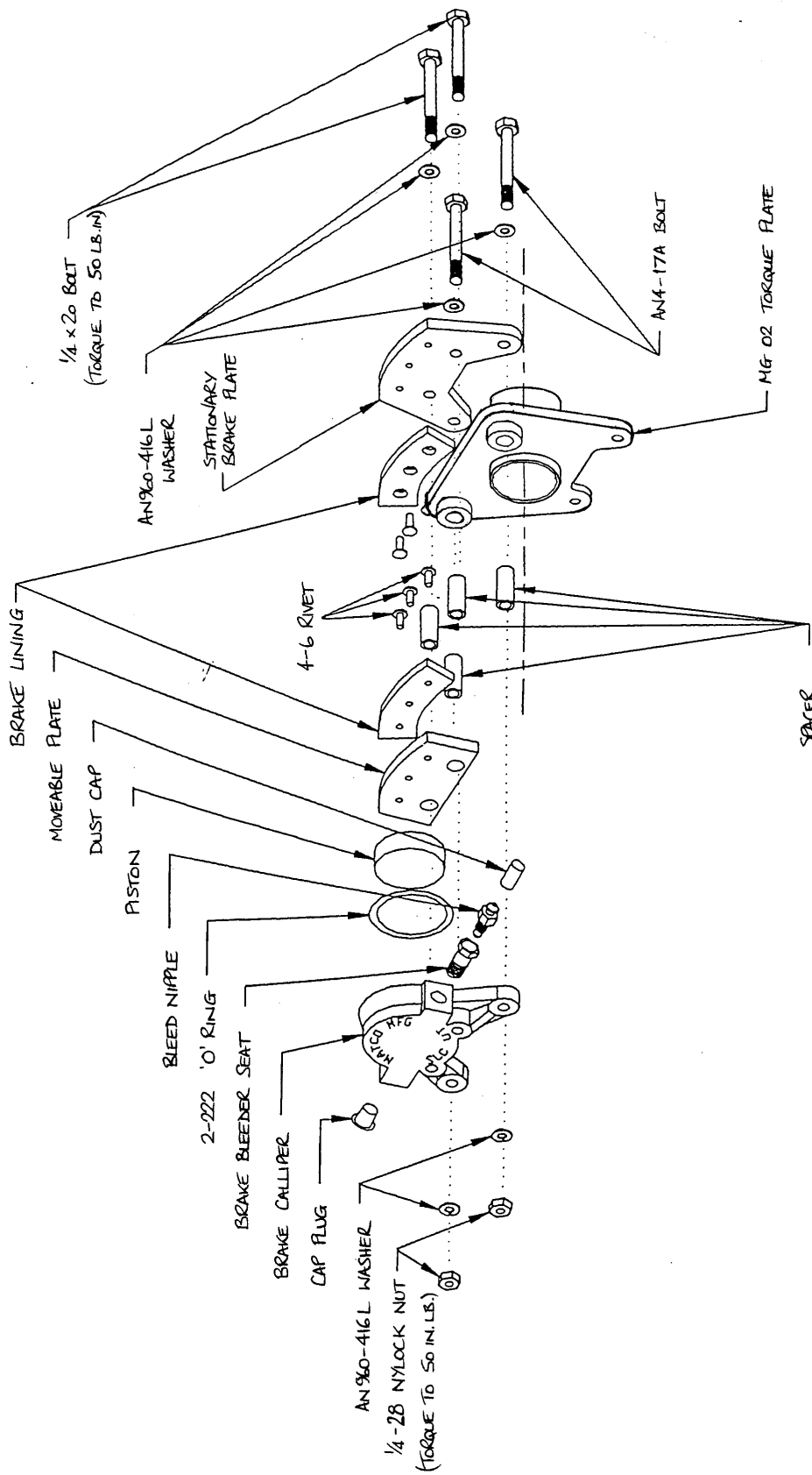
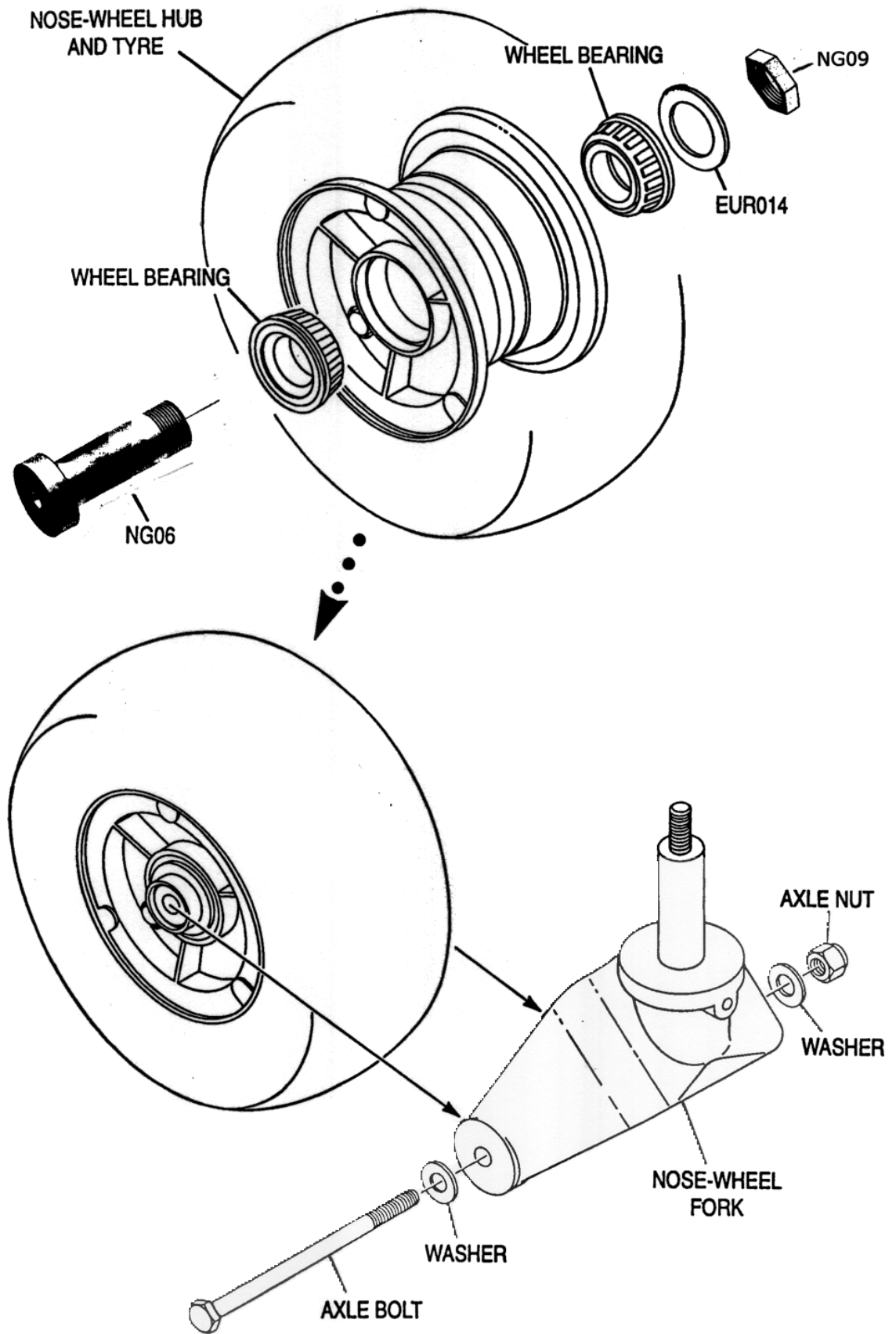


Fig 9. Routing of cable - shown external to aircraft for clarity.









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