Technical Bulletin 00/17

Masts and Towers – safety of guy fittings guidance on the inspection of swageless terminations

The contents of this Bulletin are Mandatory. The Bulletin gives warnings concerning corrosion which can occur under shrink wrap coverings on guy terminations and the need to undertake thorough and detailed inspections.

Note this Technical Bulletin (TB) is a reissue of TB 95/21 under a new issue number only. The contents of the TB have not been updated for this issue but will be reviewed in due course.

MANDATORY

SUBJECT CONTACT POINT:
Wind Sensitive Structures Specialist Services
Sutton Coldfield Mil extn 2174
Direct Dialling 0121 311 2174

DEFENCE ESTATES
MINISTRY OF DEFENCE

July 2000
Masts and Towers – safety of guy fittings guidance on the inspection of swageless terminations

INTRODUCTION

1. The contents of this Bulletin are MANDATORY. No work involving expenditure is to be entered into without prior written authority of the Property Manager or the appropriate MOD officer responsible for the facility.

2. This Bulletin has been written to promulgate the inspection policy for Norseman swageless terminations. However, the guidance offered in the Annex may be appropriate to the inspection of other types of fittings, particularly those which are covered by heat shrink sleeves.

3. This Bulletin concerns Norseman swageless terminations on plastic impregnated steel guys as used on masts and similar structures. It gives warnings that unless adequate inspection is being undertaken corrosion can take place undetected.

4. There has been a recorded failure of a plastic impregnated guy adjacent to its fitting. The failure resulted in the total collapse of a 65m mast and the loss of the communications equipment it was supporting.

REQUIREMENT

5. Property Managers are to instruct their EWCs to identify all guys which utilise Norseman swageless terminations fitted with a heat shrink sleeve.

6. Where such fittings are discovered and where there is insufficient documentation to confirm that they have been in service for less than 10 years, the EWC must qualify the Masts and Towers Structural Condition Certificate (M&TSCC), DWS Form R8, at Box 2.4 in manuscript in the following manner;

2.4 There are defects to the STRUCTURE which make the structure UNSAFE. Defects are as follows:

   Covered Guy fittings identified in excess of 10 years old - removal of heat shrink sleeve and in depth inspection required

7. The M&TSCC must remain qualified until a full and in depth inspection has been undertaken requiring the total removal of the heat shrink sleeve and any other covering from around the guy to fitting interface. Following a successful inspection the fitting is to be reinstated using Denso paste and Denso tape.

8. Subsequent inspection of the fittings shall ensure that the Denso tape covering is removed if signs of deterioration of the tape or corrosion of the fitting is observed or after a maximum period of six years. The sequence and findings of all inspections is to be recorded on the Property File.
9. It is strongly recommended that in order to reduce confusion and potential errors, the fittings are identified in accordance with the Standard Masts and Towers Nomenclature System as detailed in DE Technical Bulletin 00/16 (formerly issued as Technical Bulletin 95/19).

10. All occurrences reportable under Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR) are to be notified to the Health and Safety Executive. Major injuries, fatalities and dangerous occurrences, as defined in these Regulations, are also to be reported to the Health and Safety Section of the Estate Support Group DE, Sutton Coldfield.

11. Property Managers are requested to report all occurrences involving the actual failure of guys or their associated fittings to the Subject Contact Point. Routine preventative maintenance and replacements need not be reported.

BACKGROUND

12. Guys for radio masts may be constructed from many different materials. The most common is steel wire rope either in its basic form as galvanised wire rope (GWR) or as Norslay®. Norslay is the trade name for a composite rope constructed from 7 x 7 or 7 x 19 GWR impregnated with black ultra violet inhibited polypropylene.

13. Plastic impregnated guys may be terminated in a number of ways including helical rope grips, compression ferrules and swageless terminations. With Norseman swageless terminations the plastic protective coating has to be fully removed from the end of the rope before the fitting can be formed. As the rope's protective coating has been removed, the termination is usually completed by covering the termination guy interface with a heat shrink sleeve.

14. The sleeve protects the exposed steel elements of the guy, but makes visual inspection of the guy to fitting interface impossible. Should the seal between the termination and sleeve or sleeve and rope become faulty, then water can ingress and corrosion take place beneath the sleeve. With the sleeve in place the signs of corrosion may be less obvious and the severity of any fault may be missed or misinterpreted.

15. Over the weekend of 13 to 16 January 1995 a mast carrying an array antenna at RAF Milltown collapsed. The investigation has attributed the collapse to a failure of a guy rope immediately adjacent to its end termination due to severe corrosion and resultant loss of strand. The guys comprised Norslay rope and Norseman swageless terminations covered by a heat shrink sleeve. Water appears to have entered the sleeve causing corrosion of the exposed steel rope at the guy to fitting interface.

16. The RAF have issued orders banning their tradesmen from climbing any structures containing the identified fittings until thorough inspections have been completed. The procedures detailed in this Bulletin constitute the minimum inspection work required.

17. Norseman swageless terminations offer an acceptable means of terminating plastic impregnated steel wire rope and their continued use is not to be discouraged. However, it must be emphasised that subject to the environment in which they are installed, they will require regular inspection and preventative maintenance work if their full design life is to be achieved.
18. Guidance on the inspection of these terminations is given at Annex A. Where it is found necessary to replace fittings then the work must be undertaken under the control of a competent Chartered Engineer experienced in this type of work.

Bulletin Authorised By:

J LAWLER
Hd of SpS
Annex A to Technical Bulletin 00/17
Dated July 2000

GUIDANCE TO THE INSTALLATION AND INSPECTION
OF NORSEMAN SWAGELESS TERMINATIONS
WITH HEAT SHRINK SLEEVES

NOTE: These notes are offered for the assistance of personnel involved with the installation and inspection of guyed masts. The information is offered for guidance only and the inspector must satisfy himself of the validity of the recommendations with the manufacturer should a problem be encountered. All work concerned with the adequacy of the termination or changing of fittings should be under the control of a competent Chartered Engineer experienced in this type of work.

1.0 INTRODUCTION

This Annex is intended as a guide to the specification for new and inspection of existing Norseman swageless terminations particularly when fitted to plastic impregnated steel rope guys and covered with a heat shrink sleeve.

At RAF Milltown in January 1995 there has been a recorded failure of a plastic impregnated guy adjacent to a Norseman fitting where water penetrated under the heat shrink sleeve and caused severe corrosion resulting in failure at void A in Figure 3 below.

Although this document has been prepared specifically for Norseman swageless terminations onto plastic impregnated steel wire rope, the guidance offered will be relevant to other fittings. Hence other terminations onto plastic impregnated steel wire rope which are encapsulated in heat shrink sleeves should be inspected in a similar manner.

2.0 DEFINITIONS

The following definitions are intended as clarification when reading this Annex.

2.1 Guys

Guys are cable elements used to support tall slender structures typically masts and flagpoles. The type of guy considered here is steel, which is plastic impregnated.

Aspects which define the type of guy include the make-up and the lay of the strands.
Strand: A cable made up of a group of single wires such as 7 x 1 or 6 x 1. Typical section of guy strand is shown below.

![Figure 1](image)

**Figure 1**
7 x 1 Strand

Wire rope: A wire rope is one made up of multiple strands such as 7 x 7 a typical plastic impregnated section of which is shown below.

![Figure 2](image)

**Figure 2**
7 x 7 Plastic impregnated wire rope

### 2.2 Norseman swageless termination.

The Norseman swageless termination is supplied by Norseman Gibb Limited who also provide standard assembly procedures. It should be noted that as part of these procedures a sealant is introduced into the body of the unit thus inhibiting water ingress and corrosion within the actual fitting.

Figure 3 shows a typical stainless steel termination installed on a plastic impregnated wire rope. The existence of a locknut indicates that it was manufactured before 1980. This could give an indication to the age of the guy terminal assembly but cannot be judged as conclusive as the terminal can be reused. Terminations manufactured after 1980 were modified to omit the locknut.

Norseman Gibb have in the past produced a galvanised steel termination where the body is similar to the stainless model but the end fitting is forged. This is not a standard item and will only be manufactured if the order is large enough.

Alternative end fittings such as eyes and studs are available which screw into the body in a similar manner to the fork end.

The manufacturer’s instructions must be followed whenever assembling one of these connectors.
2.3 Heat Shrink Sleeving.

Heat shrink sleeving as produced by companies such as Raychem come in a number of forms including tube and repair tape both with and without adhesive on the inside.

It is normal that the heat shrink tubing has an internal meltable adhesive so surface preparation on installation is paramount to achieve a good bond to the guy and termination.

2.4 Rope Dressing.

Rope dressing is a term used to cover advanced guy greases and companies such as Bridon Ropes produce a range with varying properties to cater for particular environments. For guys, dressings similar to the following are normally specified:

a. Normal environments (Brilube 60)
   a medium thixotropic gel dressing with corrosion protection and stable properties over a wide temperature range.

b. Hostile/off shore environments (Brilube 70)
   as Brilube 60 but offering corrosion protection against marine environment.

For this particular application these dressings are not recommended as they will inhibit the effectiveness of the sleeve adhesive. A dressing similar to the following is recommended.

c. (Brilube 30)
   A semi dry thin film lubricant with penetration and corrosion resisting properties.
3.0 INSTALLATION

3.1 Norseman Gibb swageless terminations.

The installation procedures provided by the manufacturers with the termination should be worked to. In the event of a problem with the procedure the manufacturer should be consulted for advice.

3.2 Heat Shrink Sleeve.

The heat shrink sleeve must be of a UV resisting variety with a heat activated internal adhesive coating and be slid onto guy prior to the attachment of the termination. Once the termination is complete apply a coating of Brilube 30 or similar to the exposed portion of the wire between the plastic coating and connector.

Wrap the exposed area with self amalgamating tape to create a smooth transition between the plastic and connector and ensure the final surfaces are free of dirt and grease. Finally fit the heat shrink connector. The three stages are shown below.

(a) Coating the rope

(b) Creating a smooth transition

(c) Heat shrink sleeve in place

Fig 4 Stages in installing a heat shrink sleeve
4.0 INSPECTION

The inspection notes that follow are intended to give guidance covering plastic impregnated steel wire rope terminated by Norseman swageless terminations. These terminations should be covered by either a heat shrink sleeve or Denso tape. It has been assumed that the inspector carrying out the work will be experienced in this type of guy and fitting.

The scope and frequency have been given as a minimum requirement for guidance and it is anticipated that the inspector may, using his judgement, increase the scope of the inspections depending on the condition of the sample viewed.

The Fault Action tables that follow anticipate that where a fault is severe enough to consider it as affecting the strength of the element then the inspector should recommend the involvement of a suitably qualified and experienced Chartered Engineer.

4.1 Routine Inspection.
This should take place at a maximum period of 18 months and has been conceived as a visual inspection.

The routine inspection should cover every guy and termination and the scope of the inspection should only go beyond visual if evidence of distress is found.

<table>
<thead>
<tr>
<th>Fault</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Damage to sheath</td>
<td></td>
</tr>
<tr>
<td>lightning</td>
<td>remove enough of the coating to determine the magnitude of the damage.</td>
</tr>
<tr>
<td>no serious damage</td>
<td></td>
</tr>
<tr>
<td>(light rust)</td>
<td>treat rust and repair with self amalgamating tape as spelt out in section 6, or if not possible plan to replace guy</td>
</tr>
<tr>
<td>loss of section</td>
<td>call for an immediate structural appraisal supervised by a chartered engineer. Withdraw Good Condition Certificate</td>
</tr>
<tr>
<td>Split in sheath</td>
<td></td>
</tr>
<tr>
<td>no rust staining</td>
<td>repair with self amalgamating tape as spelt out in section 6, or if not possible plan to replace guy</td>
</tr>
<tr>
<td>rust staining</td>
<td>remove enough of the coating to determine the magnitude of the damage.</td>
</tr>
<tr>
<td>no serious damage</td>
<td>treat rust and repair with self amalgamating tape as spelt out in section 6, or if not possible plan to replace guy</td>
</tr>
<tr>
<td>loss of section</td>
<td>call for an immediate structural appraisal supervised by a Chartered Engineer. Withdraw Good Condition Certificate</td>
</tr>
</tbody>
</table>
### Fault Action

<table>
<thead>
<tr>
<th>Fault</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local swelling of sheath</td>
<td>check for splits and holes adjacent to the swelling and remove enough of the coating to determine the magnitude of the damage.</td>
</tr>
<tr>
<td>(potential basketing)</td>
<td></td>
</tr>
<tr>
<td>no serious damage</td>
<td>treat rust and repair with self amalgamating tape as spelt out in section 6</td>
</tr>
<tr>
<td>(light rust)</td>
<td></td>
</tr>
<tr>
<td>loss of section</td>
<td>call for an immediate structural appraisal supervised by a Chartered Engineer. Withdraw Good Condition Certificate</td>
</tr>
<tr>
<td>Lack of adhesion of sleeve</td>
<td></td>
</tr>
<tr>
<td>Water seepage or rust</td>
<td>remove sheath and inspect fully</td>
</tr>
<tr>
<td>staining from under the sleeve</td>
<td></td>
</tr>
<tr>
<td>no serious damage</td>
<td>treat rust if any, then reinstate with Denso tape as spelt out in section 5</td>
</tr>
<tr>
<td>(light rust)</td>
<td></td>
</tr>
<tr>
<td>loss of section</td>
<td>call for an immediate structural appraisal supervised by a Chartered Engineer. Withdraw Good Condition Certificate</td>
</tr>
</tbody>
</table>

### 4.2 10 year Inspection.

The 10 year inspection should also be carried out on guy systems of indeterminate age. Should the Norseman swageless termination have a locknut and no supporting evidence as to its age it should be assumed to be over 10 years old.

The scope of the 10 year inspection is to cover a full in depth visual inspection of all terminations requiring the removal of all sleeving and non permanent covering.

Prior to inspection the rope to fitting interface must be totally exposed (see Fig 4a) and the total area cleaned.

<table>
<thead>
<tr>
<th>Fault</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>no serious damage</td>
<td>treat rust and reinstate with Denso tape as spelt out in section 5</td>
</tr>
<tr>
<td>(light rusting)</td>
<td></td>
</tr>
<tr>
<td>loss of section</td>
<td>call for an immediate structural appraisal supervised by a Chartered Engineer. Withdraw Good Condition Certificate</td>
</tr>
</tbody>
</table>

Following successful inspection the termination shall be reinstated with Denso tape in accordance with section 5.
4.3 Post 10 year Inspection.

At the 18 month maximum intervals a selection of the terminations should have their sleeves removed and be inspected whilst the balance should be visually inspected in accordance with section 4.1.

The number of terminations having their sleeves removed should be calculated such that over a 6 year period all terminations have been inspected at least once.

<table>
<thead>
<tr>
<th>Fault</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>signs of light corrosion</td>
<td>increase the number of terminations fully inspected. Treat and reinstate with Denso tape as directed in section 5</td>
</tr>
<tr>
<td>loss of section</td>
<td>call for an immediate structural appraisal supervised by a chartered engineer. Withdraw Good Condition Certificate</td>
</tr>
</tbody>
</table>

5.0 REINSTATEMENT

This procedure describes a Denso paste/Denso tape system which should provide a 6 year life in the majority of environments. In particularly aggressive environments the fitting will require more frequent in depth inspections and reinstatement.

Where other procedures and materials are proposed these must be submitted to the Subject Contact Point for approval prior to use.

5.1 Health and Safety

Denso tape and Denso paste. Both Denso tape and Denso paste are manufactured by:

Winn & Coales (Denso) Ltd
Denso House
Chapel Road
West Norwood
London
SE27 0TR
Tel No. 0208 670 7511
Fax No. 0208 761 2456

Both materials have an 'effect on health' and prolonged and repeated contact may irritate the skin.

Prior to handling these products the Safety Data Sheet should be read and adhered to. The Safety Data Sheet is available from the manufacturer.

5.2 Denso Tape

Starting with a clean termination and guy fill the area between the guy and the termination with Denso paste to present a smooth transition. The tape direction is important and the first wrap should be performed 'down hill' with the second wrap 'up hill'. This will result in a finish that will shed water.

July 2000
Wrap under moderate tension ensuring that each wrap of Denso overlaps the previous one by half of its width. The Denso should cover at least 100mm of the guy.

The second wrap shall be in the opposite direction to the first.

Having completed both layers of Denso using hands (suitably protected) commence at the start end of the Denso, firmly smooth down the tape in the direction of the twist.

6.0 GUY SLEEVE REPAIR

6.1 Self amalgating tape

Thoroughly clean the area for a distance of 75mm beyond the damage in each direction.

When applying the tape all surfaces and hands must be dry and free and from grease or other contamination that would degrade the adhesion of the tape to itself.

The tape should start at least 50mm beyond the damaged area and on a smooth section of the sheath and the wrap should be a continuous length over the section to 50mm beyond the damaged area. The tape should be used under tension so that it reduces to two thirds its width with an overlap of half its width.

Having completed the first pass the operation should be repeated in the opposite direction without breaking the tape during the pass.

On completion the finished work should be thoroughly inspected to ensure good even coverage of the taped area with no 'misses' evident.