Morgan Advanced Materials

Technical Support - Linear Current Collection

Probable Causes and Possible Remedies

1) Current Overload

Morganite grade data sheets give figures for normal design currents. These can be exceeded for short periods, but actual running currents for each application must be established. The limiting factor is static current loading.

The worst current loading conditions is encountered with new carbons on new wire. Under this condition, the area of contact is at its minimum. If the current exceeds the maximum permitted value under this condition (calculated from Morganite graphs), overheating can occur which may soften or burn through the wire. With worn carbons and wire the permissible static current loading is significantly higher.

This can often be overcome by using a wider, or an extra, carbon strip. Metalised carbons have a higher static loading limit but attention must also paid to the effect of increased weight.

2) Low Contact Force

Contact force should be checked regularly over the full operation of the pantograph movement. Correct force is determined by the overhead design.

Low force results in loss of contact, sparking and reduced life. Differences between pantographs on the same system normally indicate problem areas.

Contact force can be effected by bearing problems, or a change in head design and weight.

3) Poor Wire Condition

The interface between carbon and wire is dependent on wire condition. A rough wire will increase collector wear causing pan-head disturbance and mechanical damage.

If carbon is used on its own, the wire condition will eventually improve, and remain good. However, if metal collectors are used on their own, or in conjunction with carbon, the wire is likely to be rough.

4) Poor Current Path

Poor electrical contact between carbon and pantograph can give rise to a number of problems. Where the current is shared between two connections or strips, a high resistance on one will force current through the other. This unequal load may cause overloading, overheating or short life.

Burning of metal sheaths and carriers are signs of this. Arc erosion of the carbon may occur if its connection to the sheath is unsound.

When fitting, it is important to ensure all terminations and mating surfaces are clean.

5) Wrong Material

Mixing of plain carbon grades with metalised can give problems due to unequal sharing. See Mixed Running.

6) Poor Wire Stagger

The wear pattern on the strips is dependent on the wire stagger. Good stagger gives even wear across the entire length of the strip. Heavy wear in one area or even grooving can result from incorrect stagger. The problem is exacerbated by the fact that, once a groove has been developed, wire movement is further restricted. Eventually, wire damage may occur.

Some improvements may be achieved by increasing the amount of contact length of carbon. However, the only solution is to correct the overhead stagger pattern – not always a practical proposition.

7) Pantograph Condition

Correct pantograph operation is essential to good current collection. Any deficiencies will be recorded in the condition of carbons and carriers. A sole pantograph displaying this indicates the need for further inspection.

The inspection should include contact pressure, current path, bearing condition and general condition of the pantograph.

8) Wire Suspension

Carbon strips perform better on tensioned wire than slack wire systems. In addition, a larger wire size will increase impact force by virtue of its increased mass.

Although wire tension can be altered, many of these features cannot. However, they must be appreciated.

9) Sectional Insulator Setting

Insulators are normally set at track-centre and, thus, carbon strips will tend to show resultant damage in one place only.

Typical damage may include chipping, breakage or burnt and eroded areas due to arcing. This problem is more prevalent on tramways and LRT systems due the numbers involved.

10) Pivot Angle

Head pivot angle influences stability and, thus, wear rate. Larger angles give better results, but head width is normally limited by the section insulators.

When converting from metal to carbon collectors, stability is usually improved by increasing strip width.

11) Head Mass

Head Mass is critical to the ability of the strips to stay in contact with the wire. Too heavy and contact is unstable. Unfortunately, too light a construction allows only smaller, weaker carbons to be used. Both conditions will reduce life.

Designers must constantly balance the two parameters in relation to head movement and speed to give optimum performance.

At higher speeds, this equation becomes even more important.

12) Mixed Materials

Carbon will work in conjunction with all other collector materials on a system. In trail situations this is essential to prove its viability. However, unless carbon is used exclusively, it cannot develop a protective patina on the wire and many of its benefits will be lost. Different grades of carbon can be mixed on a system without problems, but see Mixed Running below.

13) Mixed Running

Different grades of carbon should not be mixed on the same pan-head or an electrically connected pantograph. Problems may arise through mixing plain and metalised carbons as well as from mixing grades produced by different manufacturers. These may be as a result of differing wear rates, mechanical strength and electrical properties.

14) Weather Conditions

Weather conditions on a system can vary greatly with time and route allowing a range of wear rates and performance to be experienced. In particular, ice on the wire will cause rapid wear, although this may affect only the first vehicles out from a fleet. The carbon patina will help to reduce the degree of icing.

For this reason, comparisons between different grades should be carried out at the same time under similar conditions.

15) Badly Fitted Strips

Badly fitted strips will result in poor electrical connection and mechanical strength. Defects will need careful inspection to determine any pattern common to pan-heads.

16) Carbon Section too Small

Too small a section could give insufficient current carrying capacity and mechanical strength. However, increasing the size will require consideration regarding the weight and the effect on the aerodynamics.

17) Carbon Section too Big

This may result in too heavy a pan-head – see Head Mass. Current loading must be determined before reducing size.

18) High Contact Force

Too high a contact force may tend to lift the wire to the detriment of pan-head performance. The increased mechanical forces can result in broken carbons. A similar effect can occur at high speed due to aerodynamics increasing the contact force.

19) Vehicle Speed

Aerodynamics will tend to increase contact force – see High Contact Force. Higher speeds will also accentuate any other problems present. It is, thus, important to carry out checks at maximum service speed.