NATIONAL VARIATIONS:

Delete the first paragraph and *replace* with the following:

New parts shall be obtained from the manufacturer. Damaged parts may be repaired; however, the degree of ingress protection and temperature classification as stipulated on the certification label shall be preserved.

8.2.2 Cable or conduit entries

Entries shall preserve a minimum IP54 degree of ingress protection, in accordance with the requirements of IEC 60529, and at least the same IP rating as the equipment was originally designed for.

8.2.3 Terminations

The design of terminations in terms of the materials and construction used, the creepage and clearance distances and the comparative tracking indices of termination insulation will normally be fully specified in the certificate documents. Replacement parts shall be obtained from the manufacturer or his advice sought regarding acceptable alternatives.

Where terminations are loose leads, the methods of termination including insulation shall be in accordance with the certificate documentation.

8.2.4 Insulation

Comprehensive details of the insulation system of windings, including the type of impregnation varnish, are normally included in the certificate documentation. Where this does not apply, full information shall be sought from the manufacturer or determined by detailed inspection of the original winding.

NATIONAL VARIATION:

Add the following to the end of the paragraph:

Where the insulation type has been determined via detailed inspection, these details are to be included in the repair report.

8.2.5 Internal connections

If internal connections are to be renewed, the insulation on such connections shall not be electrically, thermally or mechanically inferior to that originally supplied.

The cross-sectional area of any replacement connection shall not be less than that originally fitted. The permitted methods of connecting conductors are given in the relevant standards.

NATIONAL VARIATION:

Add the following after the second paragraph:

NOTE: The bunching of more than six cables has been identified as a particular risk of producing hot spots which can affect the integrity of the increased safety type of explosion-protection.

8.2.6 Windings

8.2.6.1 General

The electrical construction of Type of Protection "e" equipment decisively influences the explosion safety and the repairer shall be in full possession of the necessary information and equipment. The whole of the winding shall be restored to the original condition except that a

partial winding replacement may be possible on larger equipment where this may be practicable.

NATIONAL VARIATION:

Delete the following from the end of the second sentence:

except that a partial winding replacement may be possible on larger equipment where this may be practicable

Add the following to the end of the last paragraph:

A partial winding replacement may be possible where restoration of the windings to the original condition can be achieved.

Any failure of an Ex "e" or Ex "eb" motor in service due to winding over temperature requires root cause analysis to determine the failure mode. The customer should be made aware of the serious nature of the failure and ensure that not only do they have a solution to prevent re-occurrence of this failure, but apply it to all the other machines in the Zone 1 area. This may require alterations to their maintenance procedures, condition monitoring, or additional sensors.

8.2.6.1.1 For machines with a rated voltage of 1 000 V or less; machines evaluated to IEC 60079-7:1969, 1990 or 2001:

The following repair techniques are acceptable:

- stator windings replaced with those provided by the manufacturer;
- · stator windings replaced based on manufacturer's winding data;
- copy winding techniques.

The following winding data are required to be able to repair the stator winding and maintain the original t_{E} :

- a) type of winding for example, single-layer, double-layer, etc.;
- b) winding diagram;
- c) number of turns/conductors/slot, parallel paths per phase;
- d) interphase connections;
- e) conductor size;
- f) insulation system, including slot insulation and the generic varnish system or process such as VPI or trickle;
- g) measurement or calculation of resistance/phase or between terminals;
- h) coil pitch;

i) winding projection, including clearance between coils and enclosure.

NOTE 1 Converter-fed motors are not protected using the concept of t_{E} , but are protected either with embedded temperature sensors or by the inherent design of the converter.

Where copy rewind techniques are being used, all of the following are required:

- a) Where there is a risk of damaging the core when stripping out the old winding, a core flux test shall be conducted, at an appropriate value, such as 1,5 T (50 Hz) or 1,32 T (60 Hz), before and after stripping winding to verify condition of core. The core losses after stripping shall be no greater than 110% of the core losses before stripping.
- b) Removal of stator winding shall be by use of chemical stripping, controlled pyrololysis (temperature controlled burn out) where the stator temperature does not exceed 370 °C or cold stripping process.

- c) The cross section area of the conductor shall be no less than the cross section area of the original winding and not greater than 103% of the cross section area of the original winding.
- d) The type of winding used on the original winding shall be used for the rewind for example, single-layer, double-layer, lap, concentric, etc.
- e) The number of conductors/slot, and parallel paths per phase shall be as in the original winding.
- f) The mean length turn of the coil shall be no greater than the original winding coil or preferably reduced.
- g) The stator winding projection shall be the same as the original winding.
- h) Embedded temperature sensors shall be fitted in the same location as the temperature sensors in the original winding.
- i) The generic varnish system process shall be the same as used in the original winding, such as trickle epoxy resin, solvent free resin using VPI, or triple dip with pre-heating and cure in resin with solvent
- j) After impregnation but before curing, the stator bore shall be cleaned. This is in order to minimise the need for stator bore cleaning after the stator winding is cured, which can increase stray losses.
- k) The resistance/phase or between terminals shall be within ± 5% of the original winding.

NOTE 2 The EASA/AEMT Rewind Study titled *The Effects of Repair/Rewinding on Motor Efficiency* published by EASA & AEMT provides additional information on Best Practice during rewinding & repair. This document is available as a free download from www.easa.com or www.iecex.com.

NATIONAL VARIATION:

Add the following after the first paragraph:

When copy winding repair is undertaken, the repairer should establish if the winding being replaced is an original winding or a repaired winding, then establish from previous repair records that the previous winding is to equivalent specifications as the original winding.

Add the following note to item h):

NOTE: These should be tested to ensure correct operation prior to and after fitment.

8.2.6.1.2 For machines with a rated voltage of greater than 1 000 V; machines evaluated to IEC 60079-7:1990 or 2001:

In addition to the revised requirements of 8.2.6.1.1:

Unless the insulation system has been previously subjected to the stator incendivity tests of IEC 60079-7:1990 or 2001, the complete motor windings shall be subjected to the stator incendivity tests of IEC 60079-7:1990 or 2001 as applicable.

NOTE 1 Equipment evaluated against the requirements of IEC 60079-7:1969 or 1990, was not subjected to additional requirements for high-voltage machines. These machines, if returned to original condition, will likely only comply with the requirements of the standard to which they were originally evaluated.

NOTE 2 Additional information on the evaluation of stator windings and insulation systems based on the IECEx Decision Sheet DS2013/006 (available from www.iecex.com) can be found in Annex D.

8.2.6.2 Repair of rotating machine rotors

A faulty bar-wound rotor shall be replaced by a new rotor produced by the original manufacturer or repaired using materials of identical specification. Particular care is necessary to ensure that, when replacing bars in a cage rotor, such bars are tight in the slots. The method of achieving tightness employed by the manufacturer should be adopted.

A faulty die-cast cage rotor shall be replaced by a new rotor produced by the original manufacturer.

If the original manufacturer is no longer able to supply a replacement it is possible to produce a new rotor winding with identical characteristics to the original.

NOTE Identical characteristics includes materials and dimensional characteristics of shorting ring and ventilation aides.

Damage to the external surface of the shorting ring of a die cast rotor including ventilation stirres can be repaired

8.2.6.3 Testing after repair of windings

8.2.6.3.1 General

After complete or partial repair, windings shall be subjected, with the equipment assembled, to the following tests so far as is reasonably practicable.

a) The resistance of each winding shall be measured at room temperature and verified. Replacement winding resistance should not differ from the original winding resistance by more than 5%. In the case of polyphase windings, the resistance of each phase or between line terminals shall be balanced. Unbalance (i.e. the difference between the highest and the lowest values) shall be less than 5% of middle value.

NOTE 1 If the winding resistance of the repaired winding differs from that of the original winding (either obtained from the original manufacturer's data, measurement from an undamaged winding, or derived by calculation from the damaged winding) by more than 5%, additional thermal tests may be required to confirm continued conformity to the stated insulation class and temperature class.

NOTE 2 In the event that the winding resistance is unbalanced, it should be verified by a competent person that the specific motor is suitable for the intended application.

b) An insulation resistance test shall be applied to measure the resistance between the windings and earth, between windings where possible, between windings and auxiliaries, and between auxiliaries and earth. The minimum test voltage of 500 V d.c. is recommended. Minimum acceptable insulation resistance values are a function of rated voltage, temperature and type of equipment and whether the rewind is partial or complete.

NOTE 3 The insulation resistance should not be less than 20 M Ω at 20 °C on a completely rewound equipment intended for use up to 690 V.

- c) A high-voltage test, in accordance with a relevant equipment standard, shall be applied between windings and earth, between windings where possible, and between windings and auxiliaries attached to the windings.
- d) The transformer or similar equipment shall preferably be energized at rated supply voltage. The supply current, secondary voltage and current shall be measured. The measured value shall be compared with that derived from the manufacturer's data, where available, and in polyphase systems should be balanced in all phases, as far as is reasonable.
- e) High-voltage (for example, 1 000 V a.c./1 500 V d.c. and above) and other special equipment may require additional tests. This shall be the subject of the repair or overhaul contract.

8.2.6.3.2 Rotating machines

In addition to the above tests, rotating machines shall be subjected to the following tests so far as is reasonably practicable.

a) The machine shall be run at rated speed and rated voltage, to check bearing temperature, noise or vibration and no load current values. The cause of any untoward increase in bearing temperature, noise and/or vibration shall be investigated and corrected. Unbalance in no load current shall be less than 5% of middle value.

NOTE 1 When the rated speed is a range of values, the test should be run at the highest practicable speed within that range.

b) The stator windings of cage machines shall be energized at nominal voltage, with the rotor locked to verify the current I_A and the resulting ratio I_A/I_N within the tolerances of ± 10%. If the voltage needs to be reduced due to the test equipment the current and current ratio shall be calculated in accordance with common engineering rules. Current unbalance of less than 5% of the middle value is acceptable. (The test is used to confirm the integrity of the stator winding and its connections and to indicate the presence of rotor defects.)

The stator windings of cage machines shall be energized at an appropriate reduced voltage, with the rotor locked, to obtain between 75% and 125% of full-load current and to ensure balance on all phases. (The test, which in some respects is an alternative to a full-load test, is used to confirm the integrity of the stator winding and its connections and to indicate the presence of rotor defects.) Unbalance of less than 5% of the middle value is acceptable.

NOTE 2 Where this test is not reasonably practical other means of verification should be used.

c) High-voltage (for example, 1 000 V a.c./1 500 V d.c. and above) and non-cage machines may require alternative and/or additional tests. This shall be the subject of the repair or overhaul contract.

NOTE 3 Guidance on test voltages and additional tests for rotating machines is given in IEC 60034, or the manufacturer's recommendation may be obtained for special circumstances.

NATIONAL VARIATIONS:

Delete "IEC 60034" from Note 3 and replace with "the AS 60034/IEC 60034 series standards".

8.2.6.4 Temperature sensors

8.2.6.4.1 Repaired windings

If embedded temperature sensors were included to monitor winding temperatures, it is recommended that an identical replacement be embedded in the same location in the repaired winding before varnishing and curing.

8.2.6.4.2 Overhaul

It is recommended that temperature sensors be checked and if defective replaced as part of any overhaul. If replacement is required, temperature sensors shall be as specified in the documentation prepared in accordance with IEC 60079-0, and shall be installed as specified in that documentation. Replacement of defective embedded temperature sensors during an overhaul, which are required as part of the certificate documentation, will necessitate a stator rewind.

NOTE If the documentation is not available, or the identical temperature sensors are not available, the acceptability of the replacement should be assessed and documented by the responsible person.

NATIONAL VARIATION:

Add the following after the paragraph and before the note:

On no account shall arcing or sparking devices be permitted within an Ex "e" enclosure, except where another type of appropriate explosion-protection enclosure, selected in accordance with AS/NZS 60079.0 and for equal gas grouping, houses such an arcing/sparking device.

8.2.7 Light-transmitting parts

No attempt shall be made to repair light-transmitting parts and only replacement components provided by the manufacturer shall be used. Light-transmitting parts or other parts made of plastic shall not be cleaned with solvents. Household detergents may be used.

NATIONAL VARIATION:

Delete the paragraph and *replace* with the following:

Light-transmitting parts shall not be repaired.

Where the full specification obtained from the manufacturer is available, a new lighttransmitting part may be fitted, provided the fitting is performed in accordance with the manufacturer's verified and documented procedure. Where the full specification cannot be obtained, only complete replacement assemblies, as specified by the manufacturer, shall be used.

Light-transmitting or other parts made from plastics shall not be cleaned with solvents. Household detergents are recommended for this purpose.

8.2.8 Encapsulated parts

In general, encapsulated parts (for example, switching devices in luminaires) are not considered suitable for repair or reclamation.

8.2.9 Batteries

Where batteries are used, reference shall be made to the manufacturer's instructions before carrying out any repair or replacement.

8.2.10 Lamps

Lamp types specified by the manufacturer shall be used as replacements and the maximum wattage specified shall not be exceeded.

Special care shall be taken with single-pin tubular fluorescent tubes. The single pin, when inserted in the lampholder, forms a flameproof enclosure and distortion or misalignment may affect the designed explosion protection.

8.2.11 Lampholders

Only replacements specified by the manufacturer shall be used. In those cases where the wiring to the lampholder is factory-made (crimps, etc.), rewiring shall not be undertaken unless the repairer has the equipment to make up the wiring to the same standard.

NOTE Lampholders for type of protection "e" luminaires are invariably of specific types, either single-pin for tubular fluorescent lamps or screw for other types.

8.2.12 Ballasts

Chokes, and capacitors, shall be replaced only by the manufacturer's listed parts, if obtainable. If these are no longer obtainable, an equivalent may be used, if verified by a person with competency in the compliance of the equipment or component being replaced and the type(s) of protection standards.

8.2.13 Breathing devices

Breathing devices shall be serviced to maintain the explosion protection properties of the enclosure in accordance with documentation. If this documentation is not obtainable, breathing devices shall be replaced only by those parts listed in a certificate documentation. If breathing devices carry an Ex component certificate, only a suitably certified and dimensioned part can be used.

8.3 Reclamation

Reclamation using the techniques detailed in Clause 4 may be used with the type of protection "e" equipment subject to the following restrictions of this clause.

8.3.1 Enclosures

8.3.1.1 General

If minor damage to enclosures, terminal boxes and covers is to be repaired by welding or metal stitching, care shall be taken to ensure that the integrity of the equipment is not significantly impaired as to degrade the type of protection, in particular, that it remains capable of withstanding the impact test and maintains the degree of ingress protection.

8.3.1.2 Joints

If damaged or corroded joint faces are to be machined, the mechanical strength and operation of the component shall not be impaired nor the degree of ingress protection affected.

Where joints are provided to achieve close tolerance location, machining the male part may require addition of metal to it and also machining of the female part (or vice versa) to retain the location properties of the joint. If only one part is damaged, that part may be restored to its original dimensions by the addition of metal and re-machining. The addition of metal shall be by electroplating, sleeving or welding, but metal spraying techniques which have a bond strength less than 40 MPa is not recommended.

8.3.1.3 Shafts and housings

If shafts and bearing housings are to be reclaimed, this may be carried out by use of metal spraying or sleeving techniques. Welding may be appropriate with due regard to the limitations of this technique (see 4.4.2.2.9).

8.3.2 Sleeve bearings

Sleeve-bearing surfaces may be reclaimed by electroplating, metal spraying or welding (except MMA) techniques.

8.3.3 Rotors and stators

If rotors and stators are to be skimmed to remove eccentricities and surface damage, the resulting increased air gap between rotor and stator may produce a change in surface temperatures that could then exceed the temperature class of the machine. If uncertainty exists with regard to possible adverse effects on the temperature class; the repairer shall seek guidance, preferably from the manufacturer, before this procedure is adopted.

Skimmed or damaged stator cores shall be submitted to a "flux test" to ensure that there are no remaining hot spots which adversely affect the temperature classification or cause subsequent damage to the stator windings.

The repairer shall seek and follow advice from the manufacturer before this procedure is adopted or the equipment is re-tested in accordance with the type of protection standard.

8.4 Modifications

8.4.1 Enclosures

Enclosures may be modified provided that the specified temperature classification, degree of ingress protection and impact test requirements of the appropriate standards are met.

NATIONAL VARIATION:

Delete the paragraph and *replace* with the following:

Alterations defined in the certificate shall be verified by a responsible person. Enclosures may be modified provided that compliance with the appropriate standards is confirmed by a certificate.

8.4.2 Cable and conduit entries

Special care shall be taken to ensure that if alteration is made to entries, the specified type of protection and degree of ingress protection are maintained.

8.4.3 Terminations

No modification of terminations shall be made without reference to the manufacturer.

8.4.4 Windings

Rewinding of the equipment for another voltage or connection shall not be carried out without guidance from the manufacturer and provided that, for example, the magnetic loading, current densities and losses are not increased, new appropriate creepage and clearance distances are observed, and the new voltage, t_E time and I_A/I_N ratio are within the limits of the certificate documentation. The rating plate shall be changed to show the new parameters.

Rewinding a rotating machine for a different speed shall not be carried out without guidance from the manufacturer, since the electrical and thermal characteristics of the machine could be significantly altered to the point of being outside the limits of the certificate documentation. The rating plate shall be changed to show the new parameters.

8.4.5 Auxiliary equipment

In cases where additional auxiliary equipment is requested, for example, anti-condensation heaters or temperature sensors, the manufacturer shall be consulted to establish the feasibility of and the procedure for the proposed modification.

9 Additional requirements for the repair and overhaul of equipment with type of protection "n"

NATIONAL VARIATION:

Add the following to the end of the clause title:

or "ec"

9.1 Application

This clause contains additional requirements for the repair, overhaul, reclamation and modification of equipment with type of protection "n". It shall be read in conjunction with Clause 4, which contains general requirements, and any other appropriate clauses if relevant. The relevant equipment standards which shall be referred to when repairing or overhauling an Ex "n" equipment are those to which the equipment was originally manufactured (see IEC 60079-15).

NATIONAL VARIATION:

Delete the first paragraph and *replace* with the following:

This clause contains additional requirements for the repair, overhaul, reclamation and modification of equipment with type of protection "n" or "ec". It shall be read in conjunction with Clause 4, which contains general requirements, and any other appropriate clauses if relevant. The relevant equipment standards which shall be referred to when repairing or overhauling an Ex "n" or Ex "ec" equipment are those to which the equipment was originally manufactured (see AS/NZS 60079.7 or AS/NZS 60079.15).

Verifying the integrity of non-sparking equipment shall be completed in accordance with the evaluation procedures and parameters described in Appendix ZD. The results of the various dimensional checks, inspections and tests nominated shall form part of the report to the user.

NOTE: HB 239 provides practical assistance and methods for verifying the integrity of explosion-protected equipment.

9.2 Repair and overhaul

9.2.1 Enclosures

Whilst it is preferable to obtain new parts from the manufacturer, in principle, damaged parts may be repaired or replaced with others, given that the degree of ingress protection and temperature classification as stipulated on the label is preserved.

NOTE The specific IP rating is integral to type of protection "n". The performance of gaskets and seals is critical to maintaining that IP rating and has been subjected to special conditioning and testing and should only be replaced with gaskets and seals of identical materials and identical construction.

A more stringent degree of ingress protection than that specified in the equipment standard may have been provided to cater for environmental conditions, in which case any repair shall not jeopardize such higher degree of ingress protection.

Particular attention is drawn to the impact test requirements of all parts of the enclosure as given in the equipment standard.

Adequate clearance shall be maintained between stationary and rotating parts in accordance with the equipment standard.

Restricted breathing enclosures depend for their explosion protection on gaskets and other means of sealing. The condition of the sealing arrangements may adversely affect the type of protection.

Attention is drawn to the effect of surface finish, paint, etc. on the temperature classification of enclosures.

NATIONAL VARIATION:

Add the following to the end of the first sentence in the note:

or "ec"

9.2.2 Cable and conduit entries

Entries shall preserve a minimum IP54 degree of protection in accordance with the requirements of IEC 60529.

9.2.3 Terminations

Care shall be taken when refurbishing terminal compartments to maintain clearances and creepages in accordance with the equipment standard. Where non-metallic screws are used for fixing, only replacement screws of similar materials shall be used.

Where terminations are loose leads, the method of termination including insulation shall be in accordance with the certificate documentation.

9.2.4 Insulation

A class of insulation the same as or superior to that originally provided shall be employed, for example, a winding insulated with class E material may be repaired using class F material (see IEC 60085).

9.2.5 Internal connections

If internal connections are to be renewed, the insulation on such connections shall not be electrically, thermally or mechanically inferior to that originally supplied.

The cross-sectional area of any replacement connection shall not be less than that originally fitted.

9.2.6 Windings

9.2.6.1 General

The electrical construction of type of protection "n" equipment decisively influences the explosion safety and the repairer shall be in full possession of the necessary information and equipment. The whole of the winding shall be restored to the original condition except that a partial winding replacement may be possible on larger equipment where this may be practicable.

For machines evaluated to IEC 60079-15:1987 or 2001, one of the following repair options shall be employed:

- stator windings replaced with those provided by the manufacturer;
- repair based on manufacturer's winding data;
- copy winding technique, which includes determination of winding connections, conductor size, turns, coil pitch, winding projection, and may include a determination of the original coil resistance.

For machines with a rated voltage of 1 000 V or less, evaluated to IEC 60079-15:2005 or 2010, one of the following repair options shall be employed:

- stator windings replaced with those provided by the manufacturer.
- repair based on manufacturer's winding data;
- copy winding technique, which includes determination of winding connections, conductor size, turns, coil pitch, winding projection, and may include a determination of the original coil resistance.

For machines with a rated voltage of greater than 1 000 V, one of the following repair options shall be employed, ensuring that, unless the insulation system has been previously subjected to the stator incendivity tests of IEC 60079-15:2005 or 2010, the motor windings shall be subjected to the stator incendivity tests of IEC 60079-15:2005 or 2010. For IEC 60079-15:2005, the end user has the option of advising that the risk factors used for the original assessment against IEC 60079-15:2005 indicated a low potential for stator winding discharge, and therefore the stator incendivity tests were not performed: