PERFORMANCE STANDARD FOR

TRANSFER SWITCHES FOR USE WITH ENGINE/GENERATOR SETS

EGSA 100S, 1996

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1. SCOPE

This standard applies to transfer switch equipment which is designed primarily for use with engine/generator sets used as the standby or emergency source of power and for which there is load interruption (break before make operation) during transfer.

Rated voltage covered in this standard shall not exceed 600 VAC and includes equipment provided with or without an enclosure.

2. REFERENCE STANDARDS

The following, with latest revisions thereof, are listed as engineering references to be added to the purchase specifications where applicable:

EGSA 101G-1995	Glossary of Electrical and Mechanical Terminology and Definitions
EGSA 101S-1995	Engine Driven Generator Sets Guidelines Specification for Emergency or Standby
NFPA 20-1993	Installation of Centrifugal Fire Pumps
NFPA 70-1996	National Electrical Code Articles 250, 445, 517, 700, 701, 702, 705
NFPA 99-1996	Health Care Facilities
ANSI/IEEE 100-1992	Standard Dictionary of Electrical and Electronics Terms
IEEE 241-1990	Recommended Practice for Electric Power Systems in Commercial Buildings
IEEE 446-1987	Recommended Practice for Emergency and Standby Power Systems
NEMA ICS 10-1994	A.C. Transfer Switches
UL 1008, 4th ed., 1989 (NRTL)	Automatic Transfer Switches
CSA 22.2 178 (NRTL)	Automatic Transfer Switches

3. DEFINITIONS

Automatic Transfer Switch. An automatic transfer switch is self-acting equipment for transferring one or more load conductor connections from one power source to another (NEMA Standard Definition 10-2.1).

Available Short-Circuit Current. The available short-circuit current is the maximum current a power system can deliver through a negligible-impedance short-circuit applied at a given point. The available short-circuit current may be limited by the use of current-limiting fuses or circuit breaker.

Closing Current. The closing current is that value of short circuit current, expressed in rms symmetrical amperes and maximum voltage ratings, which the transfer switch, with its contacts initially open, must close onto.

Contact Transfer Time. Contact transfer time is the time measured from the parting of one set of main contacts to the closing of a second set of main contacts on an alternate power supply.

Main Contact. A contact included in the main circuit of a transfer switch which, when closed carries the current from either source to the load. Main contacts are used for each phase and, if required, the neutral.

Monitored Source Deviation. Monitored source deviation is a variation in the power supply being monitored that signals the transfer switch to operate. Typical source deviations are changes in voltage and frequency.

Non-Automatic Transfer Switch. A non-automatic transfer switch is a device, the operation of which is manually initiated or manually operated, for transferring one or more load conductor connections from one power source to another.

Operating Sequence. The operating sequence of an automatic transfer switch consists of the automatic transfer of load from the normal supply to the alternate supply in the event of a monitored source deviation and automatically returning the load to the normal supply when it is restored. The transfer may be with or without predetermined time delays.

Operating Transfer Time. Operating transfer time is the time measured from the instant of the monitored source deviation to the closing of main contacts on an available alternate power source excluding any purposely introduced time delay.

Switching Pole. The portion of a switching device associated exclusively with one electrically separated conducting path of its main circuit.

Total System Transfer Time. Total system transfer time is the time from the instant of the monitored supply deviation to the time of contact making with the fully energized alternate supply. It includes any purposely introduced time delay, as well as the time required for the alternate supply to be fully energized.

Transfer Signal. Transfer signal is the signal which commands the transfer switch to operate.

Withstand Current Rating. The withstand current rating is the value of short circuit current, expressed in rms symmetrical amperes, which the contacts of the transfer switch, with contacts closed, must endure.

4. RATINGS

4.1 The ratings for transfer switches will consist of following:

- 4.1.1 **Voltage**. The voltage ratings shall be no less than the system voltage rating, and include, but are not limited to, 120, 208, 480, or 600 volts, single phase or polyphase.
- 4.1.2 **Current**. The continuous current ratings shall be no less than what is required to be compatible with the system based on an ambient temperature of 40°C.
- 4.1.3 **Frequency**. The frequency rating shall be the same as the system nominal frequency, and include, but not limited to, 50 Hz, 60 Hz, or 400 Hz.

4.1.4 **Withstand Current**. The withstand current ratings shall be no less than the available short circuit current at the transfer switch terminals, and be compatible with the type and rating of protective devices utilized.

4.1.5 **Closing Current**. The closing ratings shall be no less than the withstand rating.

4.1.6 **Number of Poles**. The number of poles shall be no less than the number of ungrounded conductors in the system, and may include an additional pole for switching the neutral. The neutral pole must be equal in rating to the phase or line pole(s).

5. CLASSIFICATIONS

5.1 **Functional Classification**. Transfer switches are classified by "Automatic" or "Non-Automatic" and by the class of the load they are designed to transfer.

5.1.1 **Method of Operation**
Automatic
Non-Automatic

5.2 **Classification Based On Load Characteristics**. Transfer switches shall be designed to control one or more of the following classes of loads:

5.2.1 **Total System Load**. Consisting of any combination of motors, electric discharge lamps, electric heating (resistive) loads and tungsten lamp loads provided the latter does not exceed 30% of the continuous current rating of the transfer switch.

5.2.2 **Tungsten Lamp Load**. Consisting entirely of tungsten lamps.

5.2.3 **Electric Discharge Lamp Load**. Consisting of electric discharge lamps including fluorescent lamps.

5.2.4 **Resistive Load**. Consisting of heater and other non-inductive loads in which the in-rush current does not exceed 150% of the continuous current rating of the switch.

5.3 **Classification Based on Emergency and Legally Required Systems**. Transfer switches are classified by inclusion in Emergency and/or Standby Systems.

5.3.1 **Emergency systems** are those legally required to automatically supply alternate power within 10 seconds of power interruption to prescribed functions essential for safety to human life.

5.3.2 **Legally required standby systems** are those legally required to automatically supply alternate power to selected loads (Other than those classified as emergency systems) in the event of failure of the normal source.

5.3.3 **Optional standby systems** are intended to supply power automatically or non-automatically to selected loads other than those classified as emergency or legally required standby.

5.4 **Classification Based on Construction Type**.

5.4.1 Contactor Type.

5.4.2 Breaker Type.

6. APPLICATION DATA

The following points should be checked in order to assure proper application of the automatic transfer switch.

6.1 **Compatibility**. The transfer switch must be compatible with the ratings of the system in which it is applied (current, including continuous, withstand and closing, voltage, frequency, etc.).

6.2 **Method of Operation**. The transfer switch may be either automatic, or non-automatic as required.

6.3 **Type**. The transfer switch must be determined based on application whether it is emergency standby.

6.4 **Poles**. The number of poles required for the transfer must be determined.

6.5 **Voltage**.

6.5.1 **Matching Source**. The voltage rating of the transfer switch must be no less than the source voltages.

6.5.2 **Compatibility**. The normal and alternate voltage systems must be compatible.

6.6 **Continuous Current Rating**. The continuous ampere requirements of the transfer switch must be no less than the continuous load current. The transfer switch is not necessarily rated to match the exact engine generator full rated output which can differ as shown in the following examples:

Example 1: The transfer switch rating may be higher than the engine generator rating if some loads are disconnected prior to transfer to the engine generator set. For example, a bank of elevators may operate simultaneously on the normal source but only one at a time on the emergency generator set.

Example 2: The transfer switch rating may be lower than the engine generator set rating if a higher rated set has been used to provide motor starting capability.

Example 3: Another example would be multiple automatic transfer switches connected to one engine generator. This is common in hospital applications. In this application it is recommended that staggered transfer to emergency be provided where applicable by adding an adjustable time delay.

6.7 **Special Applications**. Automatic transfer switches are typically used in installations where the normal source is a utility source, and the alternate source is an engine generator set. Other applications involving transfer switches and engine generator sets can be:

6.7.1 **Three Source/Single Generator**. One transfer switch operates between two utility services; and if both fail, a second switch transfers the load to the generator set.

6.7.2 **Three Source/Dual Generator**. One transfer switch operates between two engine generator sets. If normal fails, a second switch transfers load to the output of one of the two generator sets as determined either by which generator is up to voltage first or by pre-selected alternating of the sets.

6.7.3 **Three Source/Dual Load/Dual Generator**. Normal source feeds both loads. One load is a priority load. If normal fails, the first generator up to proper voltage and frequency feeds the primary load, and the second generator feeds the secondary load. If the

generator feeding the primary load fails, a priority load selector switch will automatically disconnect the failed generator and reconnect the running generator.

6.7.4 **Dual Engine Generator/No Utility Source**. One engine generator acts as primary source, the other as standby. The engine generator functions are reversed periodically by either manual or automatic controls.

6.8 **Special Occupancies**. Health Care Facilities - Hospitals, nursing homes, etc., are generally required by law and insurance companies to conform to NFPA-70, National Electrical Code, (Article 517), NFPA-99, Health Care Facilities Code, NFPA-110, Emergency and Standby Power Systems. These codes and standards require special features and control arrangements.

7. PERFORMANCE SPECIFICATIONS

7.1 **Transfer Switch Voltage Rating**. The voltage rating of a transfer switch shall be no less than the system voltage rating.

7.2 **Continuous Current Rating**. The continuous current rating of a transfer switch shall be no less than the maximum continuous current requirements of the system.

7.3 **Withstand Current Rating**. The withstand current rating of a transfer switch shall be no less than the fault current available at its terminals. In some cases, it may be necessary to use a switch of a higher current rating to match the available fault current of the system.

7.4 **Closing Current Rating**. The closing current rating of a transfer switch shall be no less than the fault current available at its terminals. In some cases, it may be necessary to use a switch of a higher current rating to match the available fault current of the systems.

7.5 **Load Characteristics**. The transfer switch shall be suitable for the classification of the loads.

7.6 **Number of Poles**. The transfer switch shall be furnished with the appropriate number of poles.

7.7 **Enclosure**. The transfer switch shall be equipped with an enclosure suitable for the environment in which it is used.

7.8 **Accessories**. The transfer switch shall be equipped with accessories, as required, to provide operation as determined necessary. Refer to Section 8 for available accessories.

7.9 The transfer switch shall meet the basic safety standards set by **UL-1008**.

8. OPTIONAL ACCESSORY PERFORMANCE

8.1 **Minimum or recommended accessories** for an automatic transfer switch are as follows:

8.1.1 Full phase voltage sensing of normal source.

8.1.2 Time delay before engine start to override momentarily power dips and outages of normal source.

8.1.3 Time delay on retransfer to normal to permit stabilization of the normal source and prevent multiple power interruptions.

8.1.4 Test switch to manually simulate a normal power failure.

8.1.5 Pilot contact for engine starting.

8.1.6 Auxiliary contact closed when switch is in the normal position.

8.1.7 Auxiliary contact closed when switch is in the emergency position.

8.1.8 Voltage/frequency sensitive relay on emergency source.

8.1.9 Indicating lights to indicate the source feeding the load.

8.1.10 Time delay on engine shutdown to permit engine cooldown.

8.2 **Optional/Accessories**. Consideration may be given to the following available accessories:

8.2.1 **Battery charger**.

8.2.2 **Automatic exerciser** for the engine generator with or without load transfer.

8.2.3 **Manually controlled retransfer**.

8.2.4 **Special enclosures**.

8.2.5 **Time delay** before transfer to emergency and after the engine has started to permit warm-up or sequential loading.

8.2.6 Push-button to **bypass time delay** on retransfer to normal.

8.2.7 **External manual operator**.

8.2.8 **Transfer of motor loads**. Motors should be evaluated with respect to avoiding the consequences of abnormal in-rush currents during transfer. The consequences of reconnecting a motor to another power source while its residual voltage is high can be extremely high in-rush currents which can cause possible breaker tripping, motor damage or coupling damage. This condition can be expected to occur in motors of 50 HP or greater.

Transfer switch equipment can be arranged to prevent abnormal motor in-rush currents. Three common solutions are given below. The system designer should choose the arrangement best suited to the particular application.

8.2.8.1 **Inphase Transfer**. Inphase monitors can be added to transfer switch equipment. Initiating transfer when the normal and emergency services are inphase will reduce in-rush currents to within acceptable levels.

8.2.8.2 **Control Circuit Disconnect of Motor Loads Prior to Transfer**. This feature provides for disconnecting the motor control circuit for an adjustable time prior to transfer in either direction. Sequential reclosing may be provided if there is more than one motor on the load.

8.2.8.3 **Delayed Transition Timer**. Deliberately introducing an off-time during load transfer, thereby allowing the disconnected electrical loads to de-energize before reconnecting them to the alternate source of power. This is accomplished by introducing a time delay between the opening of the closed contacts and the closing of the open contacts.

8.2.9 **Bypass/Isolation Switches**. Maintenance is an essential requirement in any electrical installation. It is more critical in a system involving loads essential to life, such as a hospital. The system designer should consider adequate and safe means to permit maintenance and service to the automatic transfer switch, and at the same time provide continuity of power to the essential load circuits. A bypass/isolation switch is a means of providing this capability.

8.2.10 **Load Shed Control Relay**. To automatically transfer a non-essential load transfer switch back to a de-energized normal source if a generator failure occurs in a multiple generator set scheme.

8.2.11 **Remote Control Panels**. Panels that incorporate any combination of features including but not limited to the following 1) Test; 2) Time Delay Bypass; 3) Switch Position Indication.

9. INSTALLATION

9.1 Installation of transfer switch equipment shall be in accordance with all applicable codes, standards, and practices.

9.2 Installation of transfer switch equipment shall be in accordance with the recommendations of the manufacturer.

10. MAINTENANCE

A maintenance program and schedule should be established to meet the needs of each particular installation to insure minimum downtime. The program should include periodic testing, tightening connections, and, when recommended by the manufacturer, inspecting for evidence of overheating and excessive contact erosion, removing dust and dirt and replacement of contacts when required. Arrangements to facilitate minimum downtime are desirable.