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**GUIDELINES FOR
SPECIFYING
AND PERFORMING
INFRARED INSPECTIONS**

Guidelines for Specifying and Performing Infrared Inspections, First Edition, January 1988

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The General Guidelines are intended to be used in conjunction with one more of the Specific Guidelines to clarify the scope of services for specifying and performing infrared inspections.

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Part 1

**General Guidelines for Specifying and Performing
Infrared Inspections**

General Guidelines for Specifying and Performing Infrared Inspections

1.0 Purposes

The purposes of the General Guidelines are as follows:

- 1.1 to provide guidelines for the purchaser of infrared thermographic inspections so that the end user may receive a specified quality of information.
- 1.2 to provide basic performance guidelines for infrared thermographers,
- 1.3 to state criteria for distinguishing differences in equipment capabilities and levels of services and skills provided by infrared thermographers, and
- 1.4 to suggest specific content for the documentation associated with infrared inspections.

2.0 Definitions

For the purpose of these Guidelines,

- 2.1 a **guideline** is a set of specifications which define the intent, content and goals of a procedure.
- 2.2 **qualitative infrared thermography** is defined as the practice of gathering information about a structure, system, process or object by observing images of differential patterns of infrared radiation, and recording and/or presenting that information.
- 2.3 **quantitative infrared thermography** is defined as the measurement of infrared radiation by assigning numeric values to the observed patterns of infrared radiation.
- 2.4 the **client** is defined as the person purchasing or requesting infrared thermographic inspections from in-house personnel or from infrared thermographers outside of the client's organization, and
- 2.5 an **infrared inspection** is defined as the use of thermal imaging equipment to observe differential patterns of infrared radiation for the purpose of providing specific information concerning a structure system, object or process.
- 2.6 an **infrared thermographer** is a person who performs an infrared inspection and provides information derived from the inspection.
- 2.7 **thermographic documentation** is any photographic, videotape, computer-generated, or graphic record of information derived from an infrared inspection.

3.0 Scope

3.1 These General Guidelines are designed to be used in conjunction with one or more Specific Guidelines which define the responsibilities of both client and thermographer, the scope of work to be performed, and the content of the documentation for the specific infrared inspections.

4.0 Compliance

4.1 Compliance with these Guidelines is voluntary. However, if an infrared thermographer claims compliance with these Guidelines within bid proposals, scopes of work, promotional material, contracts or similar documents, the thermographer must comply with each and every section of both the General and the associated-Specific Guideline or Guidelines, without exception, unless otherwise specified in writing as part of that same document.

5.0 Responsibilities of the infrared thermographer

5.1 The information gathered through infrared inspections will be intended to serve the client's best interest.

5.2 The infrared thermographer will exercise reasonable care in the performance of his or her work.

5.3 The infrared thermographer usually accepts compensation from only the client directly. If an infrared thermographer has received or anticipates receiving other compensation, the sources of such compensation will be made known to the client in writing as part of the proposal to provide infrared thermographic services.

5.4 All information gathered and presented will be considered proprietary to the client. Written permission is required for other uses of the information by the infrared thermographer.

5.5 The infrared thermographer will have sufficient knowledge of the system, object or process being inspected to understand the observed patterns of radiation.

6.0 Responsibilities of the client

6.1 It is in the client's best interest to provide a person knowledgeable with the facility, object, process and/or system to be inspected and to assist the thermographer in identifying the materials and structures of all components defined by the scope of work.

6.1.1 This person will accompany the thermographer during inspections of electrical equipment.

6.1.2 This person will be readily available to the thermographer during roof moisture and building envelope inspections.

6.2 The client assumes full responsibility for consequences resulting from actions either taken, or not taken, as a result of information provided by an infrared inspection.

7.0 Equipment

7.1 The infrared thermographer will use thermal imaging equipment with capabilities sufficient to obtain accurate information appropriate to the client's needs.

7.2 The infrared thermographer who provides quantitative infrared information will assure that all infrared temperature measuring equipment meets the manufacturer's standard equipment specifications for accuracy.

7.2.1 All temperature measuring equipment will be recalibrated at intervals recommended by the manufacturer and at least every three years.

7.2.2 Documentation of such calibration(s) will be made available to the client on request.

8.0 Contractual agreements

8.1 The following items will be included in requests for infrared inspections from the client:

8.1.1 any special requirements for equipment, such as resolution, recording capability, portability or other essential features, and

8.1.2 the level of detail needed in the final documentation resulting from the infrared inspection, which can be:

8.1.2.1 verbal only, without written or thermographic documentation,

8.1.2.1.1 consisting of an inspection witnessed by the client with information shared verbally between client and infrared thermographer, and

8.1.2.1.2 A copy of the data log (see Section 9.0 below) may remain on-site as a record of the information derived from an inspection, or

8.1.2.2 written report only, without thermographic documentation, or

8.1.2.3 both written report and thermographic documentation.

8.2 At the client's request, the following items can be contained in the request for infrared inspections to supplement those listed in Section 8.1

8.2.1 evidence of insurance from the infrared thermographer to assure the existence of sufficient insurance in accordance with the client's requirements,

8.2.2 evidence of the level of expertise of the infrared thermographer, including:

8.2.2.1 any currently valid certifications of the infrared thermographer's skill level,

8.2.2.1.1 in which case, the infrared thermographer's certification number and source of certification will be required to appear on each report.

8.2.2.2 any other currently valid professional registrations, licenses, certifications or qualifications related to the performance of infrared inspections,

8.2.3 a list of several past and current clients having similar scopes of work

8.2.3.1 in which case the infrared thermographer will allow the client to contact any or all references.

8.2.4 a copy of a sample report, or a part thereof, similar to that which will be furnished to the client,

8.2.4.1 in which case the infrared thermographer will have obtained permission for the use of the report.

8.3 Proposals from an infrared thermographer to a client will include the following items in addition to information included in Section 8.1 and information requested by the client in Section 8.2:

8.3.1 the name, address and phone number of the infrared thermographer, and

8.3.2 the manufacturer(s) and model number(s) of all infrared equipment to be used during the inspection.

9.0 Data log

9.1 Whether the information is reported to the client or not, the infrared thermographer will keep a data log listing environmental, physical, and other relevant con-

ditions for each infrared inspection, provided such information is not shown on the recorded images. This data log will include the following:

9.1.1. the date and time and exact location of the infrared inspection, and

9.1.2 the characteristics of the object to be inspected including its emissivity, transmittance, reflectance, and

9.1.3 the equipment used to perform the inspection including lenses, filters, emissivity compensation features and spectral wavelength sensed, and

9.1.4. if applicable, the atmospheric conditions including ambient dry-bulb air temperature(s), solar radiation, wind, and relative humidity of the air, and

9.1.5 any other special conditions which may affect the results of the inspection.

9.2 The infrared thermographer will keep originals or copies of all data logs, written reports and thermographic documentation resulting from an inspection for either a period of three years after the inspection, or the minimum time established by the State in which the inspection was performed.

9.2.1 Upon request, the thermographer will agree to furnish any and all information about a particular infrared inspection to the client.

Part 2

**Specific Guidelines for Specifying and Performing
Infrared Inspections**

Specific Guidelines for Roof Moisture Inspections

1.0 Purposes

1.1 The purpose of these Specific Guidelines is to supplement the General Guidelines by providing specific guidelines for infrared inspections of insulated roofs.

1.2 The purpose of an infrared inspection of an insulated roof is to locate and document suspected moisture within insulation by observing and/or recording differential patterns of heat radiation on the surface of the roof.

1.3 Infrared roof inspections to detect suspected moisture in insulation are not designed to locate leaks or to determine the causes of moisture within roof insulation.

1.3.1 Infrared thermography will be presented as an inspection technique to gather and present information. Thermography will not be promoted as a remedial measure.

1.3.2 Opinions about the sources of roof leaks, integrity of the roof membrane, and recommendations for corrective actions require skills beyond those of infrared thermography.

2.0 Responsibilities of the infrared thermographer

2.1 To perform infrared roof moisture inspections, the infrared thermographer will have an understanding of roof system construction and materials.

2.2 Prior to conducting the infrared inspection, the thermographer will know the materials and construction of the client's specific roof systems, including the types and thicknesses of insulation for each roof section of different construction.

2.3 Prior to performing an infrared inspection of a roof, and accompanied by the client or client's representative, the infrared thermographer will visually inspect the roof system during daylight to locate means of access, to identify possible safety hazards, to identify any heat sources beneath the roof, and to determine the most effective procedure for inspecting the roof.

2.4 The infrared thermographer will inform the client of any limitations of the roof system construction or design, weather, thermographic inspection techniques, and/or the infrared inspection equipment, and will recommend or use other inspection techniques when it is in the client's best interest.

2.4.1 For example, when performing roof moisture inspections during warm months, moisture located in insulation under shaded roof areas may be better detected with nuclear density or electrical capacitance moisture detection methods.

2.5 The infrared thermographer will determine if any of his or her actions during the inspection could void or invalidate any roof warranties.

2.6 Destructive testing, such as taking core samples or using a galvanic moisture probe, is necessary to verify the presence of suspected moisture in insulation. If destructive testing is requested or required of the thermographer, then

2.6.1 such testing will be done only with written permission from the client, and

2.6.2 performed only by persons who are qualified to perform such destructive tests, and

2.6.2.1 this person will be responsible for making permanent, compatible and watertight repairs to the roof after such tests, and

2.6.2.2 prior to performing destructive tests, and on request from the client, the infrared thermographer will inform the client of

2.6.2.2.1 the name of the person or organization performing the tests, and

2.6.2.2.2 evidence of this person's insurance to assure coverage appropriate to the client's requirements, and

2.6.2.2.3 the type(s) of destructive tests to be performed and their procedures, and

2.6.2.2.4 the method and types of material to be used to repair the test site(s) and evidence of their compatibility with existing roofing materials.

2.7 For safety reasons, the infrared thermographer will assure that there will be at least one additional person on the roof at all times during the inspection.

3.0 Responsibilities of the client

3.1 The client will provide to the thermographer information about any roof warranties.

3.2 Prior to the infrared inspection, the client will communicate to the infrared thermographer

3.2.1 any past and current problems with the roof system, and

3.2.2 the reasons for, or goals in, conducting the infrared roof moisture inspection.

3.3 The client will provide a person to either accompany the infrared thermographer during the inspection or be readily available to the thermographer during the inspection.

3.3.1 This person will be supplied by the client and will meet the criteria described in Section 6.1 of the General Guidelines.

3.3.2 This person will be responsible for gaining access to and maintaining the security of the client's building and premises.

3.4 Destructive testing is necessary to verify the presence of suspected moisture in insulation. If destructive testing is required or requested by the client, the client will:

3.4.1 provide written permission to the thermographer to perform such tests or to subcontract the performance of such tests to a qualified person, or

3.4.2 provide a person who is qualified to perform such destructive tests,

3.4.2.1 in which case the client is responsible for performing such tests, and for making permanent, compatible and watertight repairs to the roof after such tests.

4.0 Contractual agreements

4.1 Clients' requests for infrared inspections and proposals from infrared thermographers will contain a clear scope of work to be accomplished and the level of documentation required by the client according to Section 8 of the General Guidelines and Section 6 of these Specific Guidelines.

4.2 If destructive testing to verify the presence of suspected moisture in insulation is required by the client, then the responsibilities for such testing will be as outlined in Sections 2.5, 2.6 and 3.0 of this Specific Guideline.

5.0 Conditions during inspection

5.1 Infrared roof moisture inspections will be performed when environmental and physical conditions such as solar gain, wind, surface and atmospheric moisture, and heat transfer through the roof are favorable to gathering accurate data in the client's best interest.

5.2 The infrared thermographer will exercise reasonable care while on the roof, and will avoid damaging the roof membrane and other components of the roof.

6.0 Documentation

6.1 The infrared thermographer will provide applicable documentation and maintain the data logs as required under Sections 8 and 9 the General Guidelines.

6.1.1. If destructive testing is performed, the exact location(s) of all destructive test sites will be included in the data log.

6.2 The services performed for the client may include the following additional levels of documentation:

6.2.1 painted outlines on the roof surface of areas suspected of containing wet insulation,

6.2.2 a written narrative of the inspection procedures and findings,

6.2.3 an accurate drawing of the roof with appropriate scale, orientation, and showing the roof areas which have been outlined with paint on the roof surface.

Specific Guidelines for Electrical Infrared Inspections

1.0 Purposes

1.1 The purpose of these Specific Guidelines is to supplement the General Guidelines by providing specific guidelines for infrared inspections of electrical systems.

1.2 The purpose of a qualitative electrical inspection is to identify abnormal patterns of infrared radiation from electrical components that may represent potential-problems for the client.

1.2.1 These patterns are usually caused by loose, corroded or deteriorated connections, overloads, load imbalances, or faulty components.

1.3 Opinions about the causes of these patterns, the integrity of the electrical system or recommendations for corrective actions require skills beyond those of infrared thermography.

1.3.1 Infrared thermography will be presented as a visual inspection technique to gather and present information about the electrical system at a specific time.

1.3.2 Thermography will not be promoted as a remedial measure.

1.3.3 An infrared inspection of electrical equipment does not assure proper operation of such equipment, and other tests are necessary to assure proper maintenance of electrical systems.

1.4 These Guidelines support the procedures and specifications stated in NETA 7.25¹. However, compliance with these Guidelines is independent of compliance with any other standard.

2.0 Responsibilities of the infrared thermographer

2.1 To perform electrical inspections, an infrared thermographer will understand the components and construction of electrical distribution systems, and will be accompanied by a person who is knowledgeable of the electrical systems in the facility to be inspected.

2.2 Unless he or she is a licensed electrician, a professional engineer, or has other equivalent qualifications, the infrared thermographer will not perform any tasks that are normally done by a licensed electrician, professional engineer, or similarly qualified personnel.

2.2.1 Unless so qualified, infrared thermographers will not touch any electrical components, and will maintain a safe distance therefrom.

2.2.2 Unless so qualified, the thermographer will not remove covers from or open cabinets containing electrical equipment.

2.2.3 Unless so qualified, the thermographer will not measure electric loads of the equipment being inspected when performing quantitative inspections.

2.3 If the infrared thermographer chooses to subcontract the activities listed in Section 2.2 to an individual or organization, then

2.3.1 such subcontracting will be done only with written permission from the client, and

2.3.2 these activities will be performed only by qualified persons or organizations, and

2.3.2.1 the subcontractor will be responsible for closing cabinets and replacing all removed covers, and

2.3.2.2 prior to agreeing to such subcontract, and on request from the client, the infrared thermographer will inform the client of

2.3.2.2.1 the type(s) of activities to be performed and their procedures, and

2.3.2.2.2 the name of the subcontracting person or organization and

2.3.2.2.3 evidence of the subcontractor's insurance to assure coverage appropriate to the client's requirements.

3.0 Responsibilities of the client

3.1 The client and the infrared thermographer will agree upon and list the equipment to be inspected and the order in which the inspection will be performed, so that a complete and effective infrared inspection may be accomplished.

3.2 The client is responsible for providing personnel familiar with the electrical system to accompany the infrared thermographer during the inspection.

3.2.1 The personnel will meet the criteria described in Section 6.1 of the General Guidelines.

3.2.2 Unless otherwise specified, these personnel will open or remove all necessary covers of cabinets and panels containing the electrical equipment to be inspected.

3.2.2.1 This particularly applies to equipment with interlocks which

requires bypassing the interlocks or de-energizing equipment in order to remove covers or open panels.

3.2.2.2 The client is responsible for obtaining any prior authorizations necessary for gaining access to such electrical equipment.

3.3 The client is responsible for assuring that the components are under adequate electric load, and to create such loads when and if necessary to produce meaningful information.

3.4 Unless specified otherwise, the client is responsible for measuring electric loads of equipment which is suspected of being a potential problem.

4.0 Contractual agreements

4.1 The requests for infrared inspections from the client to the infrared thermographer and proposals from the infrared thermographer to the client will contain a clear scope of work to be accomplished and the level of documentation required by the client as specified in Section 8 of the General Guidelines, and, in addition,

4.1.1 will identify the electrical system equipment to be inspected.

4.1.2 will indicate whether the electrical inspection is to be qualitative or quantitative.

5.0 Documentation

5.1 The infrared thermographer will provide the documentation required under Sections 8 and 9 of the General Guidelines.

5.2 The report to the client will contain a complete list of all of the equipment that was inspected.

5.3 For each abnormally warm or cool component located, the data log and/or report will contain the following information:

5.3.1 the description of the component being inspected,

5.3.2 the voltage, amperage rating and phase of the component,

5.3.3 the exact location of the component,

5.3.4 the date and time of the inspection,

5.4 If performing a quantitative electrical inspection, the resulting data log and/or report will include the following additional information:

- 5.4.1 the surface temperature of the component being inspected, and
- 5.4.2 the estimated or measured surface emissivity, and
- 5.4.3 the actual load on the component during the infrared inspection, and
- 5.4.4 the percentage load on the electrical equipment, calculated by dividing the measured amperage of the equipment by its maximum rated amperage, and
- 5.4.5 the surface temperature of a defined reference component, or
- 5.4.6 the ambient air temperature, and
- 5.4.7 the difference in temperature between the component being inspected and the defined reference component, or the ambient air temperature, or both.

5.5 For inspections of electrical equipment exposed to weather, the environmental conditions during the inspection, including the influences of the sun, moisture and wind, will be included in the documentation.

Footnotes:

1. NETA 7.25 National Electrical Testing Association Maintenance Specifications Manual, Section 7.25 -- "Infrared Scanning of Electrical Equipment." Available from National Electrical Testing Association Inc., P.O.Box 2076, Dayton, Ohio 45429.

Specific Guidelines for Infrared Inspections of Building Envelopes

1.0 Purposes

1.1 The purpose of these Specific Guidelines is to supplement the General Guidelines by providing specific guidelines for infrared inspections of building envelopes.

1.2 The purpose of an infrared inspection of a building envelope is to identify patterns of infrared radiation from the building envelope.

1.2.1 These patterns can indicate locations of air leakage and/or conductive energy losses through the building envelope.

1.3 Opinions about the causes of these patterns, the integrity of the building envelope or recommendations for corrective actions require skills beyond those of infrared thermography.

1.3.1 Infrared thermography will be presented as an inspection technique and will not be promoted as a remedial measure.

1.4 These Guidelines support the procedures and specifications stated in ASHRAE Standard 101-1981¹, ASTM Standard C1060 1987², and ISO Standard 6781³. However, compliance with these Guidelines is independent of compliance with any other standard.

2.0 Responsibilities of the infrared thermographer

2.1 To perform building envelope inspections, the infrared thermographer will understand the materials and construction of building envelopes.

2.2 Unless the infrared thermographer is so qualified, he or she will not perform any tasks that are normally performed by a construction tradesperson.

3.0 Responsibilities of the client

3.1 It is the client's responsibility to create relatively uniform temperatures throughout the building. Without such uniformity, differential patterns of surface radiation can be misleading.

3.2 The client will supply to the thermographer, during the inspection, a person who is familiar with the construction of the facility, and who can control the operation of the heating, ventilating and air conditioning systems.

3.2.1 This person should meet the criteria described in Section 6.1 of the General Guidelines.

3.2.2 This person will be responsible for gaining access to, and maintaining security of, the client's building and premises.

3.3 Prior to the infrared inspection, the client will inform the thermographer of

3.3.1 the past and current problems with the building's envelope, and

3.3.2 the reasons for, or goals in, conducting the infrared building envelope inspection, and

3.3.3 the location of the building's thermal boundaries, or those components of the building envelope which separate the conditioned space from the unconditioned space.

3.3.3.1 If the client specifies an infrared inspection of only part of a building, the client is responsible for defining the thermal boundaries of that part.

3.3.3.2 If the client specifies that an insulated roof be included in the thermal perimeter, then the Specific Guidelines for Roof Moisture Inspections will be followed.

4.0 Contractual agreements

4.1 Clients' requests for infrared inspections and proposals from infrared thermographers will contain a clear scope of work to be accomplished and the level of documentation required by the client according to Section 8 of the General Guidelines and Section 6 of these Specific Guidelines.

5.0 Conditions during inspection

5.1 Inspections of the building envelope for conductive heat losses will be performed when there has been a difference of at least 18 degree F. (10 degrees C.) between the inside and outside surface temperatures of the building envelope for at least three hours.

5.2 When performing infrared inspections for air leakage, the temperature difference across the thermal boundary of the building will be at least 18 degrees F. (10 degrees C.) between either

5.2.1 the outside air temperature and the inside surface temperature when inspecting the inside surfaces of the building, or

5.2.2 the inside air temperature and the outside surface temperature when inspecting the outside surfaces of the building.

5.3 Infrared inspections to locate air leakage can be performed under one of two conditions:

5.3.1 The building can be inspected under existing pressures, without artificially induced positive or negative differential pressures,

5.3.1.2 in which case the thermographer will determine which portions of the building envelope are under positive, negative and neutral differential pressures.

5.3.2 The building can be inspected under induced positive or negative pressures,

5.3.2.1 in which case the client's representative will assume the responsibility for inducing pressures using the heating, ventilating and air conditioning system, or

5.3.2.2 a blower door-type fan may be used to induce positive or negative pressures within smaller buildings, and

5.3.2.3 the infrared thermographer will determine which portions of the building are under positive and negative differential pressures.

6.0 Documentation

6.1 The infrared thermographer will provide the documentation required under Sections 8 and 9 of the General Guidelines.

6.2 The data log and/or report will contain the following additional information:

6.2.1 the exact location and orientation of any significant pattern observed, and,

6.2.2 the air and surface temperatures and their differences as described in Sections 5.2 and 5.3 of these Specific Guidelines.

6.3 When performing infrared inspections to locate sources of air leakage, documentation will also include

6.3.1 the pressures conditions, as described in Sections 5.2 and 5.3 of these Specific Guidelines.

6.4 When performing quantitative infrared inspections of building envelopes, the documentation will also include

6.4.1 the temperature difference between the significant component of the building envelope and a defined reference component, and

6.4.2 the emissivity values of the surface, and

6.4.2.1 whether these values are measured or assumed.

Footnotes:

1. ANSI/ASHRAE Standard 101-1981 — "Application of Infrared Sensing Devices to the Assessment of Building Heat Loss Characteristics." Available from ASHRAE, 1791 Tullie Circle NE, Atlanta, Georgia 30329.
2. ASTM Standard C1060, 1987 — "Thermographic Inspection of Insulation in Envelope Cavities in Wood Frame Buildings." Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.
3. ISO Standard 6781 — "Thermal insulation - Qualitative detection of thermal irregularities in building envelopes - Infrared method." Available from American National Standard Institute, 1430 Broadway, New York, New York 10081.