102.113 – ROOFING GUIDELINE

PART 1 - INTRODUCTION

1.01 OVERVIEW

A. The design team shall follow this guideline when evaluating low-slope membrane roofing systems for all projects.

B. Materials referenced herein shall be used to construct a finished and warranted roof system. To that end, all adhesives and field and flashing membranes shall be of the same manufacturer. All other materials such as insulation, fasteners, wood, coatings etc. shall be compatible with one another and shall be acceptable for use with one another by the roofing material manufacturer and/or all parties providing a warranty.

C. Low-slope roofing guideline includes selection criteria for both bituminous and non-bituminous membrane type systems for low-slope applications (less than or equal to 2:12 and equal to or greater than 1:48 slope). The term roofing "system" includes the membrane(s), insulation, protection/cover boards, air/vapor barriers, and the metal deck.

D. This guideline does not include criteria for steep-slope roofing systems.

E. This guideline does not include criteria for vegetated roofing systems.

F. General classification of acceptable types of low-slope membrane roofing is indicated below. Refer to building standard for standards by building.

1. Non-bituminous membrane type

    a. Thermoplastic membrane (weldable)

        i. Polyvinyl Chloride (PVC)
        ii. Thermoplastic Polyolefin (TPO)

    b. Elastomeric (thermoset) membrane (non-weldable)

        i. Ethylene Propylene Diene Monomer (EPDM)

2. Bituminous membrane type

    a. Built-up Roofing (BUR)

        i. Asphalt

    b. Polymer Modified Bitumen

i. Atactic Polypropylene (APP)
ii. Styrene-Butadiene-Styrene (SBS)

G. A roofing consultant should be considered for projects with greater risk, separate from or as part of an envelope consultant, in order to assist in determining appropriate system(s) based on project specific requirements. PD&C PM shall coordinate contractual obligations before engaging the design team.

H. While the final design and specifications will be non-proprietary, the design team shall consider engaging support from product representatives for technical assistance early in design and throughout all design phases, for all projects. The following manufacturers offer acceptable levels of assistance for products they offer and should be considered.

1. Carlisle SynTec Incorporated
2. CertainTeed Corp.
3. Firestone Building Products
4. GAF Materials Corporation
5. Johns Manville
6. Sarnafil Inc.
7. TAMKO Building Products, Inc.

I. Refer to the following sections for building type specific low-slope roofing system information.

1. Hospital Building Standards, Document 203.203.
2. Ambulatory Care Center Building Standards, Document 303.203.
3. Medical Office Building Standards, Document 403.203.
4. Office Building Standards, Document 503.203.

1.02 REQUIREMENTS

A. Roofing system shall be designed in accordance with all applicable building codes and regulations. Design team shall submit all required documentation to AHJ as necessary and for approval.

B. Roofing system shall be designed in accordance with FM Global requirements. Design must be submitted to FM Global for approval. Refer to FM Global's RoofNav site for information. Refer to Chapter 11, Forms for FM Global's "Checklist for Roofing Systems" form. Design team shall submit all required documentation to FM Global as necessary and for approval.

C. Building code requirements can be different from those of the membrane manufacturer or from FM Global. It is therefore important for the design team to consider the impact of all requirements and the most stringent of requirements shall apply.

PART 2 - GUIDELINE

2.01 GENERAL

A. The primary functions of a roofing membrane system is to provide a building with a watertight roof cover that is durable, strong, and resistant to climate and weathering and that accommodates expected structural movement without failure. The roofing system must retain all these properties over an extended period of time.

B. Along with the types of low-slope membrane roofing systems (PVC, TPO, EPDM, Asphalt BUR, APP, SBS) there are various options that need to be evaluated when selecting a membrane and ultimately a complete roofing system.

1. A primary consideration is the thickness of the membrane.

a. Single-ply types (PVC, TPO, EPDM) are typically offered in several thicknesses and in general, the thicker the material the better the performance. The drawback is they are a single ply and should that system fail, there is no redundancy as in the multiple ply systems.
b. A multiple ply system (Asphalt BUR, APP, SBS) has several layers of waterproofing which inherently provides redundancy of the critical waterproofing component. In very general terms, the thicker the membrane, the better that system will perform and the more the number of plies, the more redundancy there is.

2. Other considerations which influence performance and therefore selection of a roofing system include membrane attachments and exterior surface characteristics.

C. Membrane roofing systems require careful consideration of all the components and their interrelationships. Compatibility of materials, response of the system to water vapor, effects of thermal stresses on interface conditions, and weight of the roofing system can each assume major significance. Selection of the sheet membrane material is only one aspect of designing an elastomeric membrane roofing system. The Architect has the responsibility of selecting the entire roofing system, appropriate to the project's specific characteristics.

D. When roofing drawings and details are developed based on a particular manufacturer's standards, specifications shall identify the system's basis-of-design.

2.02 DESIGN CONSIDERATIONS

A. Roof slopes are not permitted to slope less than 1/4" per 12".

B. There are many factors that must be considered when selecting a low-slope roofing system. In general, the following characteristics influence the quality and selection of the roofing system. They are as follows:

1. Cost

a. Initial cost
b. Life cycle cost

2. Performance

a. Historical
b. Traffic resistance
c. Puncture resistance
d. Chemical resistance
e. Fatigue resistance

3. Life

a. Expected life
b. Warranty

4. Maintenance

a. Ability to find problems
b. Ability to fix problems
c. Maintenance of surface

5. Environmental

a. Installation impact
b. Sustainable materials
c. Sustainable characteristics

C. Other important factors to consider might include height above ground, aesthetics, cool roof considerations and reduction of energy consumption, installation time, seasonal installation challenges, material availability, skilled installer availability, weight of system, wind conditions, etc. While warranty alone should not be a determining factor for selection, it is also an important element to consider.

2.03 THERMOPLASTIC MEMBRANE EVALUATION

A. Thermoplastic membrane. Thermoplastic materials do not cross-link, or cure, during manufacturing or during their service life. Field-fabricated seams are typically welded with hot-air welders. Thermoplastic membrane seams are typically extremely reliable, resulting in a very low incidence of seam failures. These sheets are normally around 5 to 12 feet wide although some manufacturers weld the sheets together in the factory to form larger sheets. Two thermoplastic membrane roofing types are considered in these standards.

1. Polyvinyl Chloride (PVC).

a. Material Definition.

i. Polyvinyl Chloride (PVC) membrane roofing is also known as vinyl roofing. It is the oldest and most common of the thermoplastics. Vinyl is derived from fossil fuel and salt. Petroleum or natural gas is processed to make ethylene, and salt is subjected to electrolysis to separate out the natural element chlorine. Ethylene and chlorine are combined to produce ethylene dichloride (EDC), which is further processed into a gas called vinyl chloride monomer (VCM). Through polymerization, the VCM

molecule forms chains, converting the gas into vinyl resin, a very fine, white powder. This vinyl resin is then blended with additives such as stabilizers for durability, plasticizers for flexibility and pigments for color and then made into membrane sheets for roofing applications.

ii. All of the membranes produced have some sort of reinforcing scrim.

iii. It is generally available in white, grey or tan and in thicknesses ranging from 45 mil. to 80 mil. and greater.

b. Installation.

i. Membranes are either mechanically attached, or fully adhered. Loose laid and ballasted is not recommended due to the potential of the aggregate to cause the plasticizer to leach out of the membrane.

c. Advantages.

i. PVC has a long life cycle and has been used as a roofing material in the United States since the early 1970's so it has a long documented performance history.

ii. PVC has very good strength since the heat-welded seams form a permanent, watertight bond that is stronger than the membrane itself. PVC resin is modified with plasticizers and UV stabilizers, and reinforced with fiberglass non-woven mats or polyester woven scrims, for use as a flexible roofing membrane.

iii. PVC is inherently fire resistant due to the chemical composition and offers a broader range of fire ratings.

iv. PVC provides an energy-efficient roofing option due to light coloring.

d. Disadvantages.

i. PVC is subject to plasticizer migration, a process by which the plasticizers migrate out of the sheet causing it to shrink and/or become brittle. Proper material separations and design is required.

ii. PVC membranes are generally more susceptible to chemical and physical damage.

2. Thermoplastic Polyolefin (TPO).

a. Material Definition. Thermoplastic Polyolefin (TPO) is the newest of the thermoplastic roofing membranes and was introduced in the United States in the early 1990's. The material combines rubber properties from EPDM (polyethylene, propylene or other olefinic materials) with thermoplastic materials giving it the ability to be heat welded with the added benefit of greater tensile strength. Unlike PVC, TPO membrane do not rely upon plasticizers for flexibility, so embrittlement due to plasticizer loss is of less concern. All of the membranes produced have some sort of reinforcing scrim.

i. Membranes are usually white, gray, tan or black

ii. Membrane thickness is typically 45 mil. or 60 mil. although other thicknesses are available.

b. Installation.

i. Membranes are either mechanically attached, or fully adhered.

c. Advantages.

i. TPO has good strength since the heat-welded seams form a permanent, watertight bond that is stronger than the membrane itself.
ii. TPO is inherently fire resistant due to the chemical composition and offers a broad range of fire ratings.
iii. TPO offers good resistance to some chemicals.

d. Disdvantages.

i. TPO's original formulations were unstable and resulted in roofing system failures. While current compositions have apparently resolved many of the original issues, its acceptance as a roofing material is growing but still limited. In addition, many experts suggest the material has not been in use long enough for them to fully endorse the use of the system.
ii. TPO has experienced some issues with respect to cracking and hardness as a result of ultra violet exposure and the lack of a stabilizer.
iii. TPO has experienced shrinkage problems and bonding issues with adhesives in a fully adhered installation.
iv. TPO is a relatively new product on the market and as such has a limited and unproven performance history.

2.04 ELASTOMERIC MEMBRANE EVALUATION

A. Elastomeric (thermoset) membrane. Thermoset means it is in its provided and installed in its molecularly "cured" state, therefore heat welding is not possible. Rather, these membranes can only be bonded together with liquid adhesives or adhesive tapes. The only roofing type considered in the thermoset membrane category is EPDM.

1. Ethylene Propylene diene Monomer (EPDM).

a. Material Definition. EPDM (the "M" refers to M-class, includes rubbers having a saturated chain of the polymethylene type) is also referred to as vulcanized (strengthened) synthetic rubber. The diene(s) used in the manufacture of EPDM include DCPD (dicyclopentadiene), ENB (ethylidene norbornene) and VNB (vinyl norbornene). The ethylene content of EPDM is between 45% and 75% (the higher the ethylene content the higher the loading possibilities of the polymer, better mixing and extrusion). Peroxide curing these polymers gives a higher crosslink density compared to other membranes. EPDM has been and remains the most commonly used single-

ply roofing system used in the United States because of its low initial cost, availablity and ease of installation.

i. The common color is black (some manufacturers may produce white EPDM)
ii. Membranes range in thickness from 45 mil. to 90 mil. and greater. 45 mil. membranes have a reinforcing scrim and all manufacturers offer a fleece-backed option.

b. Installation.

i. EPDM membranes can be loose laid and ballasted, mechanically attached, or fully adhered.
ii. Ballasted at 10 lbs/sq.ft. with large round stones is generally the most economical and offers the quickest installation.
iii. Mechanically attached is suitable in some applications where wind velocities are low.
iv. Fully adhered is the most expensive installation method but proves to give the longest performance of the three methods. The insulation is fastened to the deck with screws and the membrane is adhered to the insulation.

c. Advantages.

i. EPDM can be the most economical choice of the low-slope membrane roofing systems.
ii. EPDM membranes are extremely resistant to weathering, and they have very good low-temperature flexibility. Black membranes are generally more resistant to weathering than white EPDM membranes.
iii. EPDM membranes are available in widths of 10', 20', 45' or more.
iv. EPDM with a polyester fleece backing can eliminate previous issues with shrinkage. A 0.045 mil EPDM with a fleece backing is 180% stronger than 0.060 mil bare EPDM.
v. EPDM with a polyester fleece backing can greatly improve the tear resistance. Fleece backing has a tear strength of 39.9N/mm compared to 13.1N/mm of that without the fleece reinforcement, more than 3X the strength
vi. EPDM with or without a polyester fleece backing holds the highest puncture rating (L4).

d. Disdvantages.

i. EPDM is susceptible to swelling when exposed to aromatic, halogenated and aliphatic solvents, and animal and vegetable oils such as those exhausted from kitchens.
ii. Moisture gain under the membrane by vapor drive (occurring on roofs with air conditioned space beneath) can be a problem if not addressed with careful detailing and a vapor barrier.
iii. EPDM seams must be carefully primed and prepared although some manufacturers offer adhesive tapes in lieu of liquid adhesives which is

proving to minimize seam failures, shorten the duration of installation and significantly reduce labor costs.

2.05 BUILT UP ROOFING MEMBRANE EVALUATION

A. BUR. Built-up roofing is the oldest method of low slope roofing still in use and therefore has a long standing, proven history. The name itself describes the way in which the roof is installed - it is a series of generally 4 layers (or plies) of fiberglass felts that are installed in hot bitumen, layer upon layer in a shingle manner. The multiple plies form a redundant waterproofing system. A protection or cover board is typically installed above the rigid roof insulation layer to which the base sheet is adhered. The most common bitumen used (and the only one considered for this standard) is asphalt however coal tar is also available for repair and re-roof conditions (coal tar pitch is forbidden by most codes and should be avoided due to health concerns). For the purposes of these standards, coal tar BUR's are not considered an acceptable system for low-slope roofing. A surfacing is required to extend the life of the membrane.

1. **Asphalt type.**

a. Material Definition. Asphalt BUR's are commonly hot-applied (and the only one considered for this standard) however cold applied is also available which incorporates solvents. The membrane is adhered to the substrate with bitumen and the base (bottom) sheet may be mechanically fastened.

i. Aggregate is commonly installed as the surfacing material. When this occurs, the top surface of BUR is a flood coat of bitumen and gravel
ii. Fluid applied coatings are a less common but still employed practice for surfacing the BUR. When this occurs, a liquid emulsion and aluminum coating is applied to the top layer of the BUR.

b. Installation.

i. Successive layers of non-organic felts (type IV fiberglass) are hot mopped on top of the insulation – substrate board is required
ii. Overlapping of seams is an important requirement
iii. Exposed surfaces (top) are needed to protect the BUR from UV degradation. Can be coatings or a flood coat of bitumen and gravel.

c. Advantages.

i. Extremely durable and long-lasting roofing system, very good traffic resistance.
ii. Roofing system has the longest successful track record of all low-slope roofing systems.
iii. Generally very low maintenance and therefore a low life-cycle cost.

d. Disadvantages.

i. May not meet FM Global requirements for fire resistance.

ii. Hot work permit required and installation will emit a strong asphalt and pitch smell
iii. Can be expensive to install.

2.06 (POLYMER) MODIFIED BITUMEN MEMBRANE EVALUATION

A. Polymer Modified Bitumen. Also referred to as Modified Bitumen or Modified Bit (MB), this system is very similar to the BUR system. One primary difference is that polymers are added to the bitumen (thus the term modified bitumen) to give it more plastic or rubber-like properties. MB type roofs are typically comprised of 2 layers - a base sheet and a cap sheet (although there are hybrid systems is in which additional plies can be installed between the base and cap sheet). A protection or cover board is typically installed above the rigid roof insulation layer to which the base sheet is adhered. The overall roof quality is greatly dependent on the quality of the materials, the composition, and the blending process. For purposes of these standards, there are 2 types of MB sheets we will consider for this standard.

1. **Atactic Polypropylene** (APP)

a. Material Definition. is one type of thermoplastic polymer and is blended with asphalt and fillers to produce continuous sheets in a roll about 3 feet wide. The prefabricated sheet, commonly referred to as a cap sheet, is typically reinforced with fiberglass, polyester or a combination of both. The sheets are typically available as smooth and unsurfaced, embedded with mineral granules of a variety of colors, or factory-surfaced with metal foil such as aluminum, copper or stainless steel. Cap sheets are either torch-applied to the base sheet or adhered in cold adhesive. APP membranes perform well in high temperature

b. Advantages.

i. APP MB roof systems are one of the most successful roof systems available.
ii. The systems are easily installed and there is an abundance of qualified contractors available.
iii. The APP MB systems offer above average ratings for a variety of factors including life cycle, strength, puncture resistance and maintenance.

c. Disadvantages.

i. APP MB roof systems are one of the most expensive systems.
ii. Torch applied cap sheet may not be permitted on all projects.

d. Installation.

i. APP base sheet is hot mopped to a substrate board and cap sheets are torch applied to base sheet. Various cap sheet surfaces include unsurfaced (smooth), granular or mineral coated, and metal foil coated.

2. **Styrene-Butadiene-Styrene** (**SBS.)**

a. Material Definition. SBS is a synthetic rubber copolymer consisting of styrene and butadiene. It is a thermoset polymer which is blended with asphalt and fillers, very similar to the thermoplastic APP. SBS sheets maintain good low temperature flexibility but are susceptible to premature deterioration when exposed to UV radiation unless protected with a surfacing material.

b. Installation.

i. SBS base sheet is hot mopped to a ¾" substrate board and cap sheets are torch applied to base sheet. Various cap sheet surfaces include un-surfaced (smooth), granular or mineral coated, and metal foil coated.

c. Advantages.

i. SBS MB roof systems are one of the most successful roof systems available.
ii. The systems are easily installed and there is an abundance of qualified contractors available.
iii. The SBS MB systems offer above average ratings for a variety of factors including life cycle, strength, puncture resistance and maintenance.

d. Disadvantages.

i. SBS MB roof systems are one of the most expensive systems.
ii. Torch applied cap sheet may not be permitted on all projects.

2.07 INSULATION EVALUATION

A. Rigid Insulation type evaluation.

1. Perlite. This is a low R-value insulation (R-2.78 per inch). It is commonly used as an insulation cover board. It has good fire resistance, but when exposed to water, it looses compressive resistance, turns to mush and can be easily compressed. ½" thick boards have a greater percentage of organic material content than do ¾" or thicker boards. Hence, when hot asphalt is applied over ½" boards, the potential for development of blisters in built-up and hot-applied modified bitumen membranes is increased. Note: A cover board is a thin layer of insulation (such as perlite or wood fiberboard) or glass mat gypsum roof board. Cover boards are commonly placed over the primary thermal insulation (typically one of the plastic foam insulations) in order to provide an enhanced property, such as improved fire resistance, compressive resistance, or to avoid blistering or avoid a compatibility problem. Cover boards are also commonly used in re-covering to provide a separation layer between the existing and new roof membranes. Some types of cover boards are sometimes specified for use directly over steel roof decks in order to provide a thermal barrier to provide fire protection between steel decks and certain types of plastic foam insulation (the IBC specifies thermal barrier requirements).
2. Polyisocyanurate: This is a closed-cell foamed plastic insulating core that is sandwiched between inorganic felt facers, glass fiber mat facers, or glass-fiber-

reinforced aluminum foil facers. A chlorine-free blowing agent (typically pentane) expands the foam material, creating the closed-cell structure. The closed-cell structure gives the insulation its high thermal resistance. This is a high R-value insulation (R-5.6 per inch using NRCA's "in-service" recommendation, or approximately 6.0 for one inch using the Long-Term Thermal Resistance (LTTR) method for determining resistance. Air diffusion into the insulation cell structure (over time) results in slight reduction of thermal resistance; however, its insulating efficiency remains higher than other rigid insulations. Polyisocyanurate insulation is available in flat boards and tapered boards. This is one of the plastic foam insulations and is widely used in low-slope roof systems.

3. Polystyrene: There are two types of polystyrene insulation, molded expanded and extruded expanded. The two types have distinctly different properties. Polystyrene is one of the plastic foam insulations and should not be in direct contact with PVC membranes, otherwise the polystyrene will leach plasticizers out of the PVC. A suitable separator needs to occur between polystyrene and PVC.

    a. Molded Expanded Polystyrene (MEPS or EPS): This is moderate R-value insulation (from slightly less to slightly more than R-4 per inch, depending upon density). The low-density product is relatively inexpensive. Solvent-based adhesive and hot asphalt disintegrate MEPS. Hence, if either of these are used, a suitable cover board needs to be installed over the MEPS. MEPS can also be decomposed at high temperature. Therefore, MEPS should not be used underneath a black membrane unless a suitable cover board is installed between the MEPS and the membrane. MEPS cells are filled with air. Therefore, unlike the other plastic foam insulations, MEPS does not thermally age (i.e., loose R-value over time). MEPS is not very resistant to water vapor—when exposed to water vapor drive, MEPS can absorb a considerable amount of moisture.
    b. Extruded Expanded Polystyrene (XEPS): This is a high R-value insulation (R-5 for products with a minimum compressive resistance of 25 psi, R-4.6 for products with a minimum compressive resistance of 15 psi). XEPS is very resistant to water vapor drive. However, as with MEPS, XEPS should not be exposed to solvent, hot asphalt or very high temperature. But unlike MEPS, in order to avoid membrane splitting, XEPS should not be used below a built-up or modified bitumen membrane (even if a cover board is installed over the XEPS). XEPS is the only insulation suitable for use above the roof membrane in protected membrane roof (PMR) systems (see section on this topic). However, boards intended for PMRs need to be specifically manufactured for this application. Some minor water absorption may occur in boards located above the membrane during the roof's service life. To account for the R-value reduction due to the water absorption, it is recommended that the roof designer reduce the board's initial R-value by 10%. XEPS boards with extremely high compressive resistance are available for use in plaza decks where high compressive loads occur.

A. Metal roof deck. The most common roof structure is 1 ½" metal deck.

1. When metal roof decks are selected, decks shall be designed in accordance with project requirements. 1 ½" x 22 gauge minimum, galvanized in accordance with ASTM A653/A653M Z275 G90. Both top and bottom surfaces shall be galvanized.

B. Concrete deck. Structural concrete decks, concrete topping slabs, and concrete filled metal decks are acceptable roofing system substrates. Coordinate with manufacturer's requirements for pullout resistance.

PART 3 - DOCUMENTATION

3.01 GENERAL

A. Insurance Requirements. All roofing systems shall be reviewed and approved by FM Global.

B. Warranty.

1. BUR. Manufacturer shall provide a minimum fifteen (15) year No Dollar Limit labor and materials warranty, and the roofing contractor shall provide a minimum two (2) year installation warranty. The roofing contractor shall have a minimum five (5) years of verifiable installation record with the manufacturer as a certified installer. Owner reserves the right to review and approve the installer's qualifications. The installer's performance on previous projects may be considered before approval is granted to use the proposed installer. Refer to building specific design standards for further requirements.

3.02 DRAWINGS

A. Architectural.

1. A roof plan should be drawn to scale and be sufficiently large to adequately convey information. It should show all penetrations and all expansion, seismic and area divider joints. The slope directions and approximate amount of slope should also be shown. The different wind uplift areas (field, perimeter and corners) should be noted. References to all penetrations, roof edges and roof-to-wall details should also be indicated on the plan. (Note: For some standard details such as plumbing vents and roof drains, rather than include the detail on the drawings, referencing the manufacturer's detail in the specification is typically sufficient unless project conditions require enhancement to the standard detail).
2. Detail equipment curbs.
3. Detail all flashings and penetrations. Where possible, termination bars should be protected.
4. Depending on project and manufacturer's requirements, consider wrapping single ply type membranes up and over tops of parapet caps.
5. Walk pads, when necessary, shall be located and identified on the plans.
6. Coordinate details with basis-of-design manufacturer. Do not duplicate generic manufacturer's standards as the final details.

B. Structural. Structural drawings must indicate the following:

1. Roof live load (including snow load)
2. Wind loads (internal and external pressures, high intensity zones)
3. All large penetrations that require opening support should be shown and dimensioned.

    a. Mechanical duct penetrations must be coordinated with the specific rooftop unit(s). Dimensions and support of opening must be indicated on plans.

PART 4 - SUPPORTING INFORMATION

4.01 GENERAL

A. See Roof Selection Matrix.

END OF DOCUMENT

RESPONSIBILITY MATRIX

The following matrix identifies those individuals, roles or departments responsible for maintaining the accuracy of the information and those responsible for providing input. Refer to Preface for detailed explanation.

	BJC HealthCare													Hospital/Entity				
	PD&C																	
	Corporate Architect	Corporate Engineer	Director of Planning	Director of Design	Director of Construction	Other:	Clinical Asset Management (CAM)	Risk Management	Real Estate	Ergonomics	Infection Prevention (IP)	Info Systems, Data, Telecom (IS)	Other:	Standards Review Committee	Facilities Engineering	Housekeeping	Security	Other:
Primary Authorship	☐	☐	☐	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Secondary Authorship	☒	☐	☒	☐	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

DOCUMENT REVISION HISTORY

The following able indicates the date the document originated and any subsequent revisions.

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2012 v1	Original Issue	G. Zipfel
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