PAVEMENT CONDITION INDEX (PCI)

http://compass.astm.org/EDIT/html_annot.cgi?D5340+12#ap00015

AC AIRFIELDS. (Taken from ASTM D5340-12, Standard Test Method for Airport Pavement Condition Index Surveys)

Alligator or Fatigue Cracking (ASTM D5340-12):

Description—Alligator or fatigue cracking is a series of interconnecting cracks caused by fatigue failure of the AC surface under repeated traffic loading. The cracking initiates at the bottom of the AC surface (or stabilized base) where tensile stress and strain are highest under a wheel load. The cracks propagate to the surface initially as a series of parallel cracks. After repeated traffic loading, the cracks connect, forming many-sided, sharp-angled pieces that develop a pattern resembling chicken wire or the skin of an alligator. The pieces are less than 2 ft (0.6 m) on the longest side.

Alligator cracking occurs only in areas that are subjected to repeated traffic loadings, such as wheel paths. Therefore, it would not occur over an entire area unless the entire area was subjected to traffic loading. (Pattern-type cracking that occurs over an entire area that is not subjected to loading is rated as block cracking, that is, not a load-associated distress.)

Alligator cracking is considered a major structural distress.

Severity Levels:

L (Low)—Fine, longitudinal hairline cracks running parallel to one another with none or only a few interconnecting cracks. The cracks are not spalled.

M (Medium)—Further development of light alligator cracking into a pattern or network of cracks that may be lightly spalled. Medium-severity alligator cracking is defined by a well-defined pattern of interconnecting cracks, where all pieces are securely held in place (good aggregate interlock between pieces).

H (High)—Network or pattern cracking has progressed so that the pieces are well defined and spalled at the edges; some of the pieces rock under traffic and may cause FOD potential.

How to Measure—Alligator cracking is measured in square feet (square metres) of surface area. The major difficulty in measuring this type of distress is that many times two or three levels of severity exist within one distressed area. If these portions can be easily distinguished from one another, they should be measured and recorded separately. However, if the different levels of severity cannot be easily divided, the entire area should be rated at the highest severity level present. If alligator cracking and rutting occur in the same area, each is recorded separately as its respective severity level.

Bleeding (ASTM D5340-12):

Description—Bleeding is a film of bituminous material on the pavement surface that creates a shiny, glass-like, reflecting surface that usually becomes quite sticky. Bleeding is caused by excessive amounts of asphaltic cement or tars in the mix or low-air void content, or both. It occurs when asphalt fills the voids of the mix during hot weather and then expands out onto the surface of the pavement. Since the bleeding process is not reversible during cold weather, asphalt or tar will accumulate on the surface.

Severity Levels—No degrees of severity are defined.

How to Measure—Bleeding is measured in square feet (square metres) of surface area.

Block Cracking (ASTM D5340-12):
Description—Block cracks are interconnected cracks that divide the pavement into approximately rectangular pieces. The blocks may range in size from approximately 1 by 1 ft to 10 by 10 ft (0.3 by 0.3 m to 3 by 3 m). Block cracking is caused mainly by shrinkage of the AC and daily temperature cycling (that results in daily stress/strain cycling). It is not load associated. The occurrence of block cracking usually indicates that the asphalt has hardened significantly. Block cracking normally occurs over a large portion of pavement area, but sometimes will occur only in nontraffic areas. This type of distress differs from alligator cracking in that the alligator cracks form smaller, many-sided pieces with sharp angles. Also unlike block cracks, alligator cracks are caused by repeated traffic loadings and are, therefore, located only in traffic areas (that is, wheel paths).

Severity Levels:
L—Blocks are defined by cracks that are nonspalled (sides of the crack are vertical) or lightly spalled, causing no FOD potential. Nonfilled cracks have 1/4 in. (6 mm) or less mean width and filled cracks have filler in satisfactory condition.
M—Blocks are defined by either: filled or nonfilled cracks that are moderately spalled (some FOD potential); nonfilled cracks that are not spalled or have only minor spalling (some FOD potential), but have a mean width greater than approximately 1/4 in. (6 mm); or filled cracks greater than 1/4 in. that are not spalled or have only minor spalling (some FOD potential), but have filler in unsatisfactory condition.
H—Blocks are well defined by cracks that are severely spalled, causing a definite FOD potential.

How to Measure—Block cracking is measured in square feet (square metres) of surface area, and usually occurs at one severity level in a given pavement section; however, any areas of the pavement section having distinctly different levels of severity should be measured and recorded separately. For asphalt pavements, not including AC over PCC, if block cracking is recorded, no longitudinal and transverse cracking should be recorded in the same area. For asphalt overlay over concrete, block cracking, joint reflection cracking, and longitudinal and transverse cracking reflected from old concrete should all be recorded separately.

Corrugation (ASTM D5340-12):
Description—Corrugation is a series of closely spaced ridges and valleys (ripples) occurring at fairly regular intervals (usually less than 5 ft) (1.5 m) along the pavement. The ridges are perpendicular to the traffic direction. Traffic action combined with an unstable pavement surface or base usually causes this type of distress.

Severity Levels:
L—Corrugations are minor and do not significantly affect ride quality (see measurement criteria below).

How to Measure—Corrugation is measured in square feet (square metres) of surface area. The mean elevation difference between the ridges and valleys of the corrugations indicates the level of severity. To determine the mean elevation difference, a 10-ft (3-m) straightedge should be placed perpendicular to the corrugations so that the depth of the valleys can be measured in inches (millimetres). The mean depth is calculated from five such measurements.

Severity	Runways and High-Speed Taxiways	Taxiways and Aprons

L	< 1/4 in. (6 mm)	< 1/2 in. (13 mm)
M	1/4 to 1/2 in. (6 to 13 mm)	1/2 to 1 in. (13 to 25 mm)
H	> 1/2 in. (13 mm)	> 1 in. (25 mm)

Depression (ASTM D5340-12):
Description—Depressions are localized pavement surface areas having elevations slightly lower than those of the surrounding pavement. In many instances, light depressions are not noticeable until after a rain, when ponding water creates "birdbath" areas; but the depressions can also be located without rain because of stains created by ponding of water. Depressions can be caused by settlement of the foundation soil or can be built during construction. Depressions cause roughness and, when filled with water of sufficient depth, could cause hydroplaning of aircraft.

Severity Levels:
L—Depression can be observed or located by stained areas, only slightly affects pavement riding quality, and may cause hydroplaning potential on runways (see measurement criteria below).
M—The depression can be observed, moderately affects pavement riding quality, and causes hydroplaning potential on runways (see measurement criteria below).
H—The depression can be readily observed, severely affects pavement riding quality, and causes definite hydroplaning potential (see measurement criteria below).

How to Measure—Depressions are measured in square feet (square metres) of surface area. The maximum depth of the depression determines the level of severity. This depth can be measured by placing a 10-ft (3-m) straightedge across the depressed area and measuring the maximum depth in inches (millimetres). Depressions larger than 10 ft (3 m) across must be measured by using a stringline:

	Maximum Depth of Depression	
Severity	Runways and High-Speed Taxiways	Taxiways and Aprons
L	1/8 to 1/2 in. (3 to 13 mm)	1/2 to 1 in. (13 to 25 mm)
M	1/2 to 1 in. (13 to 25 mm)	1 to 2 in. (25 to 51 mm)
H	> 1 in. (> 25 mm)	> 2 in. (> 51 mm)

Jet-Blast Erosion (ASTM D5340-12):
Description—Jet-blast erosion causes darkened areas on the pavement surface where bituminous binder has been burned or carbonized. Localized burned areas may vary in depth up to approximately 1/2 in. (13 mm).

Severity Levels—No degrees of severity are defined. It is sufficient to indicate that jet-blast erosion exists.

How to Measure—Jet-blast erosion is measured in square feet (square metres) of surface area.

Joint Reflection Cracking From PCC (Longitudinal and Transverse) (ASTM D5340-12):

Description—This distress occurs only on pavements having an asphalt or tar surface over a PCC slab. This category does not include reflection cracking from any other type of base (that is, cement stabilized, lime stabilized). Such cracks are listed as longitudinal and transverse cracks. Joint reflection cracking is caused mainly by movement of the PCC slab beneath the AC surface because of thermal and moisture changes; it is not load-related. However, traffic loading may cause a breakdown of the AC near the crack, resulting in spalling and FOD potential. If the pavement is fragmented along a crack, the crack is said to be spalled. A knowledge of slab dimensions beneath the AC surface will help to identify these cracks.

Severity Levels:
L—Cracks have only light spalling (little or no FOD potential) or no spalling, and can be filled or nonfilled. If nonfilled, the cracks have a mean width of 1/4 in. (6 mm) or less; filled cracks are of any width, but their filler material is in satisfactory condition.
M—One of the following conditions exists: cracks are moderately spalled (some FOD potential) and can be either filled or nonfilled of any width; filled cracks are not spalled or are lightly spalled, but filler is in unsatisfactory condition; nonfilled cracks are not spalled or are only lightly spalled, but the mean crack width is greater than 1/4 in. (6 mm); or light random cracking exists near the crack or at the corners of intersecting cracks.
H—Cracks are severely spalled with pieces loose or missing causing definite FOD potential. Cracks can be either filled or nonfilled of any width.

How to Measure—Joint reflection cracking is measured in linear feet (metres). The length and severity level of each crack should be identified and recorded. If the crack does not have the same severity level along its entire length, each portion should be recorded separately. For example, a crack that is 50 ft (15 m) long may have 10 ft (3 m) of a high severity, 20 ft (6 m) of a medium severity, and 20 ft (6 m) of a light severity. These would all be recorded separately. If the different levels of severity in a portion of a crack cannot be easily divided, that portion should be rated at the highest severity present.

Longitudinal and Transverse Cracking (Non-PCC Joint Reflective) (ASTM D5340-12):
Description—Longitudinal cracks are parallel to the pavement's center line or laydown direction. They may be caused by (1) a poorly constructed paving lane joint, (2) shrinkage of the AC surface due to low temperatures or hardening of the asphalt, or (3) a reflective crack caused by cracks beneath the surface course, including cracks in PCC slabs (but not at PCC joints). Transverse cracks extend across the pavement at approximately right angles to the pavement's center line or direction of laydown. They may be caused by (2) or (3). These types of cracks are not usually load associated. If the pavement is fragmented along a crack, the crack is said to be spalled.

Severity Levels:
L—Cracks have only light spalling (little or no FOD potential) or no spalling, and can be filled or nonfilled. If nonfilled, the cracks have a mean width of 1/4 in. (6 mm) or less; filled cracks are of any width, but their filler material is in satisfactory condition.
M—One of the following conditions exists: (1) cracks are moderately spalled (some FOD potential) and can be either filled or nonfilled of any width; (2) filled cracks are not spalled or are lightly spalled, but filler is in unsatisfactory condition; (3) nonfilled cracks are not spalled or are only lightly spalled, but the mean crack width is greater than 1/4 in. (6 mm), or (4) light random cracking exists near the crack or at the corners of intersecting cracks.
H—Cracks are severely spalled and pieces are loose or missing causing definite FOD potential. Cracks can be either filled or nonfilled of any width.

Porous Friction Courses: Severity Levels:
L—Average raveled area around the crack is less than 1/4 in. (6 mm) wide.
M—Average raveled area around the crack is between 1/4 to 1 in. (6 to 25 mm) wide.
H—Average raveled area around the crack is greater than 1 in. (25 mm) wide.

How to Measure—Longitudinal and transverse cracks are measured in linear feet (metres). The length and severity of each crack should be identified and recorded. If the crack does not have the same severity level along its entire length, each portion of the crack having a different severity level should be recorded separately. For an example see "Joint Reflection Cracking." If block cracking is recorded, longitudinal and transverse cracking is not recorded in the same area.

Oil Spillage (ASTM D5340-12):
Description—Oil spillage is the deterioration or softening of the pavement surface caused by the spilling of oil, fuel, or other solvents.

Severity Levels—No degrees of severity are defined. It is sufficient to indicate that oil spillage exists.

How to Measure—Oil spillage is measured in square feet (square metres) of surface area. A stain is not a distress unless material has been lost or binder has been softened. If hardness is approximately the same as on surrounding pavement, and if no material has been lost, do not record as a distress.

Patching and Utility Cut Patch (ASTM D5340-12):
Description—A patch is considered a defect, no matter how well it is performing.

Severity Levels:
L—Patch is in good condition and is performing satisfactorily.
M—Patch is somewhat deteriorated and affects ride quality to some extent. Moderate amount of distress is present within the patch or has FOD potential, or both.
H—Patch is badly deteriorated and affects ride quality significantly or has high FOD potential. Patch soon needs replacement.

Porous Friction Courses—The use of dense-graded AC patches in porous friction surfaces causes a water damming effect at the patch which contributes to differential skid resistance of the surface. Low-severity dense-graded patches should be rated as medium severity due to the differential friction problem. Medium- and high-severity patches are rated the same as above.

How to Measure:
Patching is measured in square feet (square metres) of surface area. However, if a single patch has areas of differing severity levels, these areas should be measured and recorded separately. For example, a 25-ft2 (2.5-m2) patch may have 10 ft2 (1 m2) of medium severity and 15 ft2 (1.5 m2) of low severity. These areas should be recorded separately. Any distress found in a patched area will not be recorded; however, its effect on the patch will be considered when determining the patch's severity level.
X1.11.4.2 A very large patch, (area > 2500 ft2 (230 m2)) or feathered-edge pavement, may qualify as an additional sample unit or as a separate section.

Polished Aggregate (ASTM D5340-12):

Description—Aggregate polishing is caused by repeated traffic applications. Polished aggregate is present when close examination of a pavement reveals that the portion of aggregate extending above the asphalt is either very small, or there are no rough or angular aggregate particles to provide good skid resistance.

Severity Levels—No degrees of severity are defined. However, the degree of polishing should be clearly evident in the sample unit, in that the aggregate surface should be smooth to the touch.

How to Measure—Polished aggregate is measured in square feet (square metres) of surface area. Polished aggregate areas should be compared visually with adjacent nontraffic areas. If the surface texture is substantially the same in both traffic and nontraffic areas, polished aggregate should not be counted.

Raveling (ASTM D5340-12):
Description—Raveling is the dislodging of coarse aggregate particles from the pavement surface.

Dense Mix Severity Levels—As used herein, coarse aggregate refers to predominant coarse aggregate sizes of the asphalt mix. Aggregate clusters refer to when more than one adjoining coarse aggregate piece is missing. If in doubt about a severity level, three representative areas of one square yard each (one square meter) should be examined and the number of missing coarse aggregate particles counted.
L—(1) In a square yard (square meter) representative area, the number of coarse aggregate particles missing is between 5 and 20, and/or (2) missing aggregate clusters are less than 2 percent of the examined square yard (square meter) area. In low severity raveling, there is little or no FOD potential.
M—(1) In a square yard (square meter) representative area, the number of coarse aggregate particles missing is between 21 and 40, and/or (2) missing aggregate clusters are between 2 and 10 percent of the examined square yard (square meter) area. In medium severity raveling, there is some FOD potential.
H—(1) In a square yard (square meter) representative area, the number of coarse aggregate particles missing is over 40, and/or (2) missing aggregate clusters are more than 10 percent of the examined square yard (square meter) area. In high severity raveling, there is significant FOD potential.

Slurry Seal/Coal Tar Over Dense Mix Severity Levels
L—(1) The scaled area is less than 1 %. (2) In the case of coal tar where pattern cracking has developed, the surface cracks are less than 1/4 in. (6 mm) wide.
M—(1) The scaled area is between 1 and 10 %. (2) In the case of coal tar where pattern cracking has developed, the cracks are 1/4 in. (6 mm) wide or greater.
H—(1) The scaled area is over 10 %. (2) In the case of coal tar the surface is peeling off.

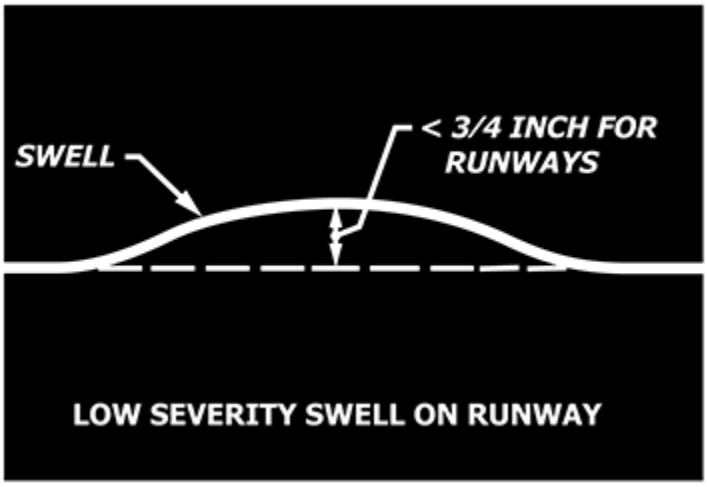
Porous Friction Course Severity
L—(1) In a square foot (1/10 square meter) representative sample, the number of aggregate pieces missing is between 5 and 20 and/or the number of missing aggregate clusters does not exceed 1.
M—(1) In a square foot (1/10 square meter) representative sample, the number of aggregate pieces missing is between 21 and 40 and/or the number of missing aggregate clusters is greater than 1 but does not exceed 25 % of the area.
H—(1) In a square foot (1/10 square meter) representative sample, the number of aggregate pieces missing is over 40 and/or the number of missing aggregate clusters is greater than 25 % of the area.

How to Measure—Raveling is measured in square feet (square metres) of surface area. Mechanical damage caused by hook drags, tire rims, or snowplows is counted as areas of high severity raveling.

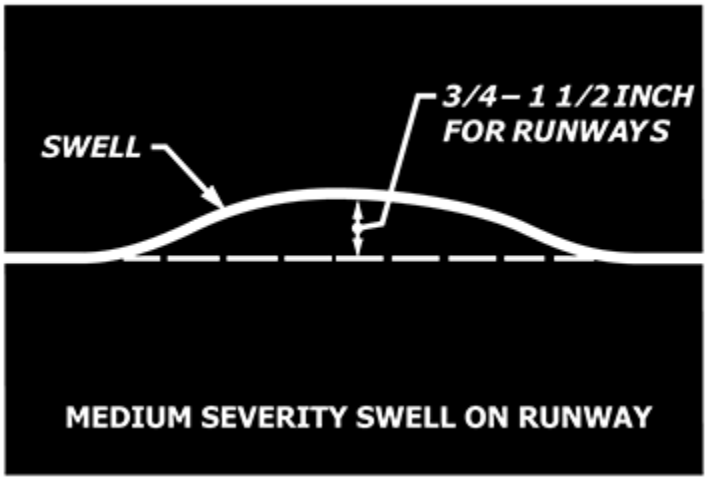
Rutting (ASTM D5340-12):
Description—A rut is a surface depression in the wheel path. Pavement uplift may occur along the sides of the rut; however, in many instances ruts are noticeable only after a rainfall, when the wheel paths are filled with water. Rutting stems from a permanent deformation in any of the pavement layers or subgrade, usually caused by consolidation or lateral movement of the materials due to traffic loads. Significant rutting can lead to major structural failure of the pavement.

Severity Levels:

Severity	All Pavement Sections
L	1/4 to 1/2 in. (< 6 to 13 mm)
M	> 1/2 to 1 in. (> 13 to < 25 mm)
H	> 1 in. (> 25 mm)



Low-Severity Swell



Medium-Severity Swell

How to Measure—Rutting is measured in square feet (square metres) of surface area, and its severity is determined by the mean depth of the rut. To determine the mean depth, a straightedge should be laid across the rut and the depth measured. The mean depth in inches (millimetres) should be computed from measurements taken along the length of the rut. If alligator cracking and rutting occur in the same area, each is recorded at the respective severity level.

Shoving of Asphalt Pavement by PCC Slabs (ASTM D5340-12):
Description—PCC pavements occasionally increase in length at ends where they adjoin flexible pavements (commonly referred to as "pavement growth"). This "growth" shoves the asphalt- or tar-surfaced pavements, causing them to swell and crack. The PCC slab "growth" is caused by a gradual opening up of the joints as they are filled with incompressible materials that prevent them from reclosing.

Severity Level:

Severity	Height Differential
L	< 3/4 in. (< 20 mm)
M	3/4 to 11/2 in. (> 20 to 40 mm)
H	> 11/2 in. (> 40 mm)

Note: As a guide, the swell table (above) may be used to determine the severity levels of shoving. At the present time, no significant research has been conducted to quantify levels of severity of shoving.
L—A slight amount of shoving has occurred and no breakup of the asphalt pavement.
M—A significant amount of shoving has occurred, causing moderate roughness and little or no breakup of the asphalt pavement.
H—A large amount of shoving has occurred, causing severe roughness or breakup of the asphalt pavement.

How to Measure—Shoving is measured by determining the area in square feet (square metres) of the swell caused by shoving.

Slippage Cracking (ASTM D5340-12):
Description—Slippage cracks are crescent- or half-moon-shaped cracks having two ends pointed away from the direction of traffic. They are produced when braking or turning wheels cause the pavement surface to slide and deform. This usually occurs when there is a low-strength surface mix or poor bond between the surface and next layer of pavement structure.

Severity Levels—No degrees of severity are defined. It is sufficient to indicate that a slippage crack exists.

How to Measure—Slippage cracking is measured in square feet (square metres) of surface area.

Swell-Distress (ASTM D5340-12):
Description—Swell is characterized by an upward bulge in the pavement's surface. A swell may occur sharply over a small area or as a longer, gradual wave. Either type of swell can be accompanied by surface cracking. A swell is usually caused by frost action in the subgrade or by swelling soil, but a small

swell can also occur on the surface of an asphalt overlay (over PCC) as a result of a blowup in the PCC slab.

Severity Levels:
L—Swell is barely visible and has a minor effect on the pavement's ride quality. (Low-severity swells may not always be observable, but their existence can be confirmed by driving a vehicle over the section. An upward acceleration will occur if the swell is present).
M—Swell can be observed without difficulty and has a significant effect on the pavement's ride quality.
H—Swell can be readily observed and severely affects the pavement's ride quality.

How to Measure:
The surface area of the swell is measured in square feet (square metres). The severity rating should consider the type of pavement section (that is, runway, taxiway, or apron). For example, a swell of sufficient magnitude to cause considerable roughness on a runway at high speeds would be rated as more severe than the same swell located on an apron or taxiway where the normal aircraft operating speeds are much lower.
For short wavelengths, locate the highest point of the swell. Rest at 10-ft (3-m) straightedge on that point so that both ends are equal distance above pavement. Measure this distance to establish severity rating.

The following guidance is provided for runways:

Severity	Height Differential
L	< 3/4 in. (20 mm)
M	3/4 to 11/2 in. (20 to 40 mm)
H	> 11/2 in. (40 mm)

Rate severity on high-speed taxiways using measurement criteria provided above. Double the height differential criteria for other taxiways and aprons.

Weathering (Surface Wear)—Dense Mix Asphalt (ASTM D5340-12):
Description—The wearing away of the asphalt binder and fine aggregate matrix from the pavement surface.

Severity Levels:
L—Asphalt surface beginning to show signs of aging which may be accelerated by climatic conditions. Loss is the fine aggregate matrix is noticeable and may be accompanied by fading of the asphalt color. Edges of the coarse aggregates are beginning to be exposed (less than 1 mm or 0.05 inches). Pavement may be relatively new (as new as 6 months old).
M—Loss of fine aggregate matrix is noticeable and edges of coarse aggregate have been exposed up to 1/4 width (of the longest side) of the coarse aggregate due to the loss of fine aggregate matrix.
H—Edges of coarse aggregate have been exposed greater than 1/4 width (of the longest side) of the coarse aggregate. There is considerable loss of fine aggregate matrix leading to potential or some loss of coarse aggregate.

How to Measure—Surface wear is measured in square feet (square meters). Surface wear is not recorded if medium or high severity raveling is recorded.