Engineering Brief No. 85

Ductile Snowplow Protection Ring
And Installation Procedures

I. PURPOSE

The purpose of this Engineering Brief (EB) is to introduce and specify requirements for a snowplow ring (SPR) that protects in-pavement light fixtures from the destructive effects of airport plowing operations without adversely affecting their photometric performance. This EB also provides field tested guidance that is critical to proper SPR installation. Both the design and installation methods presented in this EB should be recognized as only one of many possibilities for SPR design and installation.

II. BACKGROUND

In 1998, the Toronto Airport Authority (GTAA) and Tristar Electric, an electrical contractor, discussed developing a ductile metal ring that would support the asphalt surrounding in-pavement light fixtures. As the concept evolved, it was found that the ring could also be adapted to protect an in-pavement light from the destructive effects that result from the impact of a snowplow blade (see Figure 3).

With additional research and development, a ductile cast iron snowplow ring was designed that accommodated both Federal Aviation Administration (FAA) Style 2 and Style 3 light fixtures. While most varieties of cast iron are very brittle and susceptible to impact damage (shatter), ductile iron has much more impact and fatigue resistance because of nodular graphite inclusions. In addition, a casting can be mass produced at a reduced cost when compared to a fully machined steel equivalent.

In the fall of 1998, the first test SPR protected light fixtures were installed at the Toronto airport and performance results were evaluated the following spring. It was found that in-pavement light fixtures protected by the SPR during the winter survived without any significant damage despite multiple hits from snowplow blades (see Figures 14 and 15). Light fixtures not protected by the SPR were often damaged beyond economical repair and replaced (See Figure 3).

The positive results of the SPR testing led the airport authority, GTAA, to conclude that significant light fixture replacement cost savings could be realized. GTAA subsequently required that SPRs be installed with all new in-pavement light fixtures as well as back-fitting many existing in-pavement lights. To date, there are over 8,000 cast ductile iron SPRs installed at Toronto’s L.B. Pearson International Airport.

III. APPLICATION

SPRs will be useful to protect in-pavement light fixtures from snowplow blade damage at many airports in areas that receive frequent snow accumulations (see Figure 3).

IV. DESCRIPTION

The success of the SPR concept is dependent upon both proper design and installation. SPRs must be designed so that the associated light fixture photometric output is not degraded. In addition, the SPR must not decrease the load bearing or any other structural strength of the light fixture and its associated light base. In addition, procedures were developed and detailed in this EB to ensure the proper installation of SPRs. While we recognize that other designs of SPRs might use a different design or
installation procedure than presented in this EB, the procedures herein are intended to represent one method of proper installation within the constraints of the proposed design.

This EB includes step-by-step photographic illustrations of the installation procedures for a design that proposes a ductile iron SPR. The illustrations highlight procedures for new and existing light base installations in Portland Cement Concrete (PCC) or bituminous pavement.

The SPR in this EB is designed to interface with FAA Type L-868 load bearing light bases and FAA Type L-850 series/L-852 series Style 2 or Style 3 in-pavement light fixtures.

If SPRs per this EB are included in a future Advisory Circular (AC), they must be certified by an FAA-approved third party testing laboratory per AC 150/5345-53, Airport Lighting Equipment Certification Program (ALECP). Once listed in AC 150/5345-53, Addendum, the SPR will be approved for airport projects receiving Federal funds under Airport Grant Assistance or the PFC programs.

a. For the particular design in this EB, the SPRs are fabricated from cast ductile iron (per ASTM A536, alloy 65-45-12) and are black powder coated for corrosion protection.

b. Ductile iron has unique properties that allow a snowplow ring constructed from this material to withstand repeated impacts from tungsten carbide or steel snowplow blades without significant abrading, stress cracking or shattering.

c. Using a casting also eliminates a great deal of machining thereby significantly lowering SPR unit cost.

d. Equivalent materials and corrosion protection coatings are acceptable provided that the same performance as that of a ductile iron part (per ASTM A536, alloy 65-45-12) is duplicated.

e. The SPR is designed to use a silicone rubber O-ring that is functionally similar to an FAA Type L-868 light base upper flange O-ring. The O-ring will prevent any surface water from entering the light base. See AC 150/5345-42 for O-ring groove dimensions.

f. The angle of the sloped sides of both versions of the SPR is the most critical design element. The sides must rise slightly higher than the topmost surface of the light fixture. If the slope of the sides is too steep, the snowplow blade can hook into the ring and not glide over it. If the SPR sides are fabricated at too shallow of an angle, the SPR overall diameter will be unnecessarily enlarged.

See Figures 1 and 2 for detailed drawings of a proposed cast ductile iron SPR.

See Figure 4 for a photograph of a properly installed SPR. Note the smooth edges on the SPR; there are no sharp or protruding surfaces that might damage an aircraft tire.
Figure 1. SPR Dimensional Drawing

MATERIAL: DUCTILE IRON.

FINISH: BLACK POWDER COAT.

UNLESS OTHERWISE SPECIFIED:
ALL CORNER RADII TO BE .062.

NOTES:
1. MATERIAL: DUCTILE IRON.
2. FINISH: BLACK POWDER COAT.
3. UNLESS OTHERWISE SPECIFIED:
ALL CORNER RADII TO BE .062.

DO NOT SCALE DRAWING
Figure 2. SPR Detailed Dimensional Drawing
Figure 3. A Light fixture is Destroyed by a Snowplow Blade
Figure 4. An Installed Snowplow Ring - note the lack of sharp edges.
The SPR aperture for both unidirectional and bi-directional light fixtures must not change or interfere with the photometric output (see Figure 5). When seated into the SPR, the light fixture must not protrude above the SPR topmost imaginary plane – see Figure 2, Section B-B. The standard thickness for FAA 12.0-inch in-pavement Style 2 and 3 light fixtures is per AC 150/5345-46.

While SPRs are designed to mount on an FAA Type L-868B 12.5-inch outer diameter (OD) light base, with some modifications (not addressed in this EB), they could also be mounted on an FAA Type L-868C 15.5-inch (OD) load-bearing base.

An SPR must never be mounted on any non-load-bearing light base (FAA Type L-867 or per FAA-E-1315).

V. EFFECTIVE DATE

This Engineering Brief shall be effective after signature by the Manager of the Federal Aviation Administration Airport Engineering Division, AAS-100.

VI. APPLICABLE DOCUMENTS

FAA Advisory Circulars:

AC 150/5340-30G, Design and Installation Details for Airport Visual Aids, dated September 21, 2012

AC 150/5370-10, Standards for Specifying Construction of Airports

AC 150/5345-42, Specification for Airport Light Bases, Transformer Housings, Junction Boxes, and Accessories
AC 150/5345-46, Specification for Runway and Taxiway Light Fixtures

AC 150/5345-53, Airport Lighting Equipment Certification Program

**FAA Specifications:**

FAA-E-1315, *Light Base and Transformer Housing*

**ASTM International**

1.0 Installation of SPRs

The following drawings and photographs show one method for the proper installation of SPRs into either PCC or bituminous runway/taxiway surfaces. All light base installations must be per the installation requirements in AC 150/5340-30, Design and Installation Details for Airport Visual Aids. Other methods of SPR installation are subject to FAA and local airport engineering departmental approval.

The designer should be aware that any SPR installation and design will be highly dependent upon the type of pavement (PCC or bituminous) encountered and the FAA Type of light fixture. Figure 6 shows one method of SPR installation in flexible pavement.

NEW ASPHALT CONSTRUCTION

Figure 6. One Method of SPR Installation in Flexible Pavement
The key to proper installation of an SPR is aligning the core drill (Figure 7, photo #4) concentric to the light base/bolt pattern (Figure 7, photo #1). The use of a cover plate modified with the addition of a bearing in the center (Figure 7, photo #2 and #3) allows the core bit to work much like a hole saw with a pilot drill. The core bit is also modified with the addition of the center shaft (Figure 6). The shaft is a few inches longer than the core bit to facilitate proper alignment.
One of the primary installation concerns is to make the edges of the SPR flush with the surrounding pavement so that a snowplow blade will not strike it (see Figure 12). The use of a beveled pair of spacer rings specifically developed for the particular SPR in this EB (Figure 8, Photo #8 and Figure 9) makes the pavement installation adjustments much easier to accomplish. The use of the spacer rings is highly recommended to achieve an optimum fit with the surrounding pavement.
Figure 9. An Example of Beveled Spacer Rings

The embedment material selected must be compatible with the surrounding pavement. See AC 150/5370-10, *Standards for Specifying Construction of Airports*, for embedment material recommendations.
If stainless steel roll pins (Figure 10) are added to the SPR and embedded into the surrounding grout, the additional strength and resulting increase in resistance to snowplow blade impacts should significantly reduce the chance of shearing the light fixture hold-down bolts in the event of a direct impact. The pins are 1.50-inches (in.) long - driven ½-in. into the SPR casting and protrude 1-in.)
When the core drilled opening is only 0.125-inch larger than the SPR, there is very little gap space around the outside of the SPR (Figures 12 and 13). This reduces the possibility of flexible pavement slumping away from the SPR.

The use of the “Dial a Bevel” spacer pair (or an equivalent functionality) per Figure 9 also allows the installer to rotate the spacers so that the SPR does not project above the surrounding pavement.

![Figure 12. A Test SPR That is Properly Installed](image)

Note how the SPR edges on this test installation in Figure 12 are flush to the surrounding pavement (red arrows) to prevent snow plow blade engage the edges.

![Figure 13. The Proper Fit](image)

Note the tight fit (red arrow) of the SPR in Figure 13 in relation to the surrounding pavement.
One year old and still working – the test SPRs in Figures 14 and 15 withstood many snowplow blade impacts over the winter. Note that the light fixture is not severely damaged and remains operational.

Figure 14. The Light Fixture Survives Winter and Snowplows
Figure 15. Light Fixture Sustains a Snowplow Hit and Survives

VII. CONCLUSION

The SPR described in this EB has been in service for over 10 years. There are currently over 8,000 units installed. Both the design concepts and the installation methods introduced in this Engineering Brief have proven themselves in field installations.

VIII. RECOMMENDATIONS

We recommend that SPRs be used at all airports that have significant winter snow accumulation. The use of SPRs will facilitate a cost savings to airports by avoiding the routine replacement of fixtures that are damaged by snowplowing activities during the winter months.