



Air-Spaced Liners
for Metal Tubes

INSTALLATION GUIDE

TL-8
TL-10
TL-12

Kit contents:

- tube liner
- foam sheeting (used as shim material between liner and telescope tube)

General Information

The *Protostar* air-spaced tube liner is a lightweight, pre-flocked, sleeve that slips inside your metal tube. It thermally insulates the interior of your telescope by creating an air gap between the liner and tube wall. In addition, the light trap surface prevents stray light from reaching the focal plane.

The liner will fit any tube that is slightly larger than the liner itself, and they are also sized to fit the inexpensive aluminum tubing available from Hastings Pipe Company (Hastings, NE; e-mail: abeirow@hipco-ne.com; phone: 402-463-6633). Most aluminum tubes offered by other astronomy vendors originate from Hastings, so our liners will fit their tubes as well.

(Note: Hastings offers an optional inward fold on the ends of their tubes called "rolled ends". We don't recommend choosing this option with our liner. The ID reduction makes it difficult to insert the liner, and you won't be able to use the end trim we supply.)

How the Air-Spaced Tube Liner Works

Thin-walled aluminum tubing makes great telescope tubes, but with one well-known drawback. Due to the high thermal conductivity of aluminum, the inside wall of the tube will drop several degrees *below* the ambient air temperature when exposed to the night sky¹ (see **Figure 1**). This causes cooler air to spill from the upper to the lower tube wall which is detrimental to image quality². This process continues throughout the night.

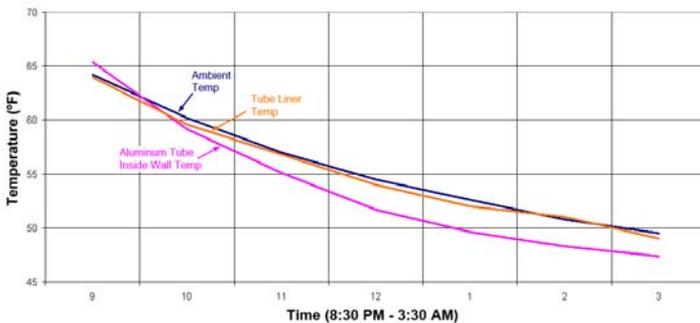


Figure 1: Temperatures recorded from 8:30 PM to 3:30 AM on a clear night showing the temperature of the upper inside wall.

¹ This is due to radiative heat loss from the outside tube surface directly to outer space. This same phenomenon causes dew on the grass before sunrise.

² As noted in Chapter 11 of J.B. Sidgwick's "Amateur Astronomer's Handbook" (ISBN 0-486-24034-7).

The traditional fix for this problem is to line a metal tube with an insulating material like cork. This is effective, but it is a time-consuming job and doesn't always look good. It also adds a surprising amount of weight when you add up the cork, adhesive, and layer of flocking.

The *Protostar* liner solves both the thermal and scattered light problem, and weighs considerably less than cork, flocking, and adhesive. While the liner wall itself provides some thermal insulation, the air gap is responsible for most of the insulation qualities. Thus, the liner should not touch the aluminum tube wall. The liner maintains an even air gap with foam spacer strips tucked into each end of the tube.

Installation Instructions

- 1) Remove the focuser, spider, primary cell, etc. If this is a new telescope, drill the mounting holes for focusers, spiders, etc. before installing the liner.
- 2) Tape wiring for dew heaters and other electronics to the inside of the telescope. The tube liner will hide the wiring making a neater appearance.
- 3) Slide the liner inside the aluminum tube, and mark with a pencil where it needs cutting. Remove and cut to length with scissors.
- 4) Insert the liner into the tube again. Cut the supplied foam sheets into 1" to 2" wide strips. Tuck the foam sheets into each end between the liner and tube wall (see **Figure 2**) using a butterknife or small screwdriver. No adhesive or tape is necessary to hold the liner in place.

Note: If you are joining two liner sections, wrap the outside of the joint with wide tape, and wrap foam strips over the joint using a small amount of adhesive or double-sided tape. Insert the liner into the aluminum tube.

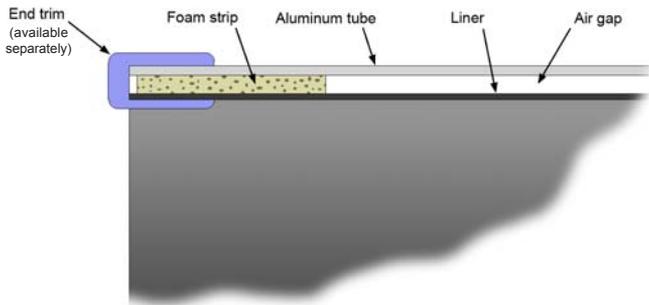


Figure 2: Cross section of typical tube end detail showing placement of foam strip and end trim.

- 5) Mark the liner holes for focusers, cells, and other accessories using the holes in the aluminum tube as a guide. Bolt holes can be pierced with a sharp tool. Larger cutouts can be cut with a utility knife or scissors. It may be easier to mark the larger holes, then partially slide the liner back out of the aluminum tube for cutting. Glue a

patch of foam around the focuser hole before cutting, and make allowances for the focuser mounting hardware.

6) Reinstall the focuser, secondary mount, primary cell, and other accessories.

Specifications

Part no.	inside dia., inches (cm)	wall thickness, inches (mm)	length, inches (cm)	weight, ounces (grams)	avg. reflectivity @ 0° AOI	avg. reflectivity @ 80° AOI
TL-8	7.65 (19.4)	0.030 (0.75)	48 (122)	14.8 (420)	< 0.4%	<0.7%
TL-10	9.65 (24.5)	0.030 (0.75)	48 (122)	19.3 (550)	< 0.4%	<0.7%
TL-12	11.45 (29.1)	0.040 (1.00)	48 (122)	25.7 (730)	< 0.4%	<0.7%

Technical Assistance

If you have a special application, or a question not covered in these instructions, feel free to call us for technical support at (614)-785-0245 (M-F 9:00 PM to 5:00 PM EST).



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