Interoffice

National Radio Astronomy Observatory

Green Bank, West Virginia

June 2, 1982

12 METER MILLIMETER WAVE TELESCOPE
MEMO No. 173

To: J. Payne

From: B. Peery, Engineering

Subject: Mirrors for 12-meter optics

We have studied ways of obtaining mirrors which conform to our interpretations of the specifications in Memo 151.

There are two possible sources:

1. Fabricate in our shop or
2. Purchase from a mirror manufacturer.

Option 1 is preferred; however, we have reservations as to whether we can meet the surface flatness and finish set forth in Memo 151. A design was developed (drawing #88D00037) and submitted to three manufacturers for a quotation. Only one responded. A copy of his quotation is attached. The price indicates we will definitely do the mirror in our shop.

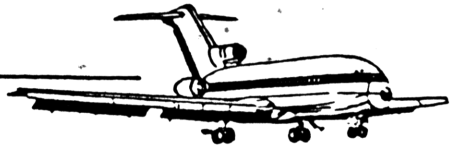
In a recent conversation you indicated we might relax the specifications. With this in mind, it is recommended we start with our shop making the mirror from Alca Plus plate (data sheet attached). We would keep open the following options, in order listed, as steps for improvments, after you have a chance to test the mirror in Tucson.

1. Have mirror surface buffed and polished.
2. Apply coilzak sheet to surface (data sheet attached). This might prove difficult to control and attach; this surface is called out on drawing #88D00037.
3. Apply an aluminized surface similar to the process used for glass mirrors in place of coilzak.
4. Have mirrors fabricated by commercial mirror manufacturers if the above steps prove unacceptable.

If you concur with this procedure, please advise and we will have the shop proceed with fabrication.

BP/bbs
Attachment.

AERO RESEARCH ASSOCIATES
P.O. BOX 109. GREAT NECK. N.Y. 11022 TEL. 212-631-7886



May 26, 1982

Mr. F. L. Beverage, Purchasing Office
National Radio Astronomy Observatory
Post Office Box 2
Green Bank, West Virginia 24944

Dear Mr. Beverage, RFQ: GB-217

We are pleased to submit the following quotation for mirrors in accordance with your drawing #88D00037 and your letter of May 12th:

Tooling	- 1,260.00
One 15" x 21.2" ellipse	- $2,200.00
Four 12" x 17" ellipses	- $1,575.00 each
Four 10" x 14.1" ellipses	- $1,275.00 each
Delivery	- 10 to 12 weeks ARO

We propose to supply a 3/8" thick aluminum plate mirror, shaped to the drawing requirements, polished and then coated wib AlSiO. In our experience, this will provide a far more satisfactory surface than Coilzak.

If there is interest in this proposal, we would be pleased to supply a sample of the proposed finish.

Please do not hesitate to contact me if you require any further information.

Sincerely,

Alvin Allen
President

AA:lm

Alcoa
Alca Plus Plate . . .
A precision product inside and out

Alcoa Alca Plus® plate is aluminum cast machined plate for manufacturers who want machining economies, reduced scrap, dimensional stability and weight savings. It's a precision product with high performance characteristics.

Alcoa Alca Plus plate is lightweight. It's machined to a smooth surface finish of 25 microinches or less on both sides and seldom requires additional machining to meet flatness requirements. It remains rigid and dimensionally stable after machining because of a stress-relieving and grain-refinement treatment at the mill. And it usually costs less per finished piece than standard wrought plate.

Fine internal qualities.

As in any precision product, the internal quality of Alcoa Alca Plus plate gives it desirable properties. Alcoa® chose a high-quality alloy for Alcoa Alca Plus plate and controls its metallurgical process precisely. A specialized casting unit and support equipment designed especially for Alcoa Alca Plus plate provides a low level of stress during the casting process. The result is a dense, fine grained and homogeneous structure—with minimum porosity.

Assured dimensional stability.

One of the key advantages of Alcoa Alca Plus plate is its stability. It is stress relieved following the casting process. And careful thermal control is maintained during the stress-relieving treatment to minimize distortion in any plane during subsequent machining. So Alcoa Alca Plus plate remains dimensionally stable.

Surface finish quality of 25 microinches or less.

Another key advantage of Alcoa Alca Plus plate is that it has a precise finish. Each piece is machined to a smooth surface finish of 25 microinches or less on both sides. An exacting flatness tolerance is maintained within 0.005-inch for an 8-foot span of plate over ⅝-inch thick, and 0.015-inch for plate ⅝-inch thick or under.

For many applications, Alcoa Alca Plus plate has a finished surface quality that eliminates the need for further surface machining. So you can specify the plate you need in the exact size you require.

Quality control.

Alcoa takes great care to assure the accuracy of Alcoa Alca Plus plate. After machining, both surfaces are given a final, careful check for flatness, and the thickness of the standard-sized plate is gauged precisely with a micrometer in eight different places. It must be within 0.005-inch of the required thickness or it is rejected.

"Kid-glove" care.

Alcoa Alca Plus plate is handled with vacuum lifts during the inspection process to assure a product that is free from handling defects. It is further protected from metal-to-metal contact during stacking by protective paper interleaving between each piece. And all shipments are wrapped securely to protect against damage in transit.

This is Alcoa Alca Plus plate.

Fine materials, advanced equipment and production techniques, strict quality control, careful handling are what make Alcoa Alca Plus plate the aluminum industry's premium quality plate.

A plate that can save you money

Alcoa Alca Plus aluminum cast machined plate is a product that is useful for diverse applications—from computer parts to machine jigs. In addition to being a dependable, precision aluminum plate, it offers features which can enable cost-conscious managers and engineers to reduce machining costs in present assemblies and to design cost savings into new products and equipment.

Reduces scrap loss, saves machining costs.

Pre-machined plate surfaces mean that Alcoa Alca Plus plate is ready to use as is, with little or no scrap loss. In fact, for most applications, additional surface preparation is necessary only if a polished finish or a surface finish quality greater than 25 microinches is desired.

Because of its properties, Alcoa Alca Plus plate is easy to saw, drill, ream, face and tap. Cutting speeds are three times faster than steel, feed rates are high and machine time is reduced. Cost per item declines. For further details, refer to Technical Data Sheet #2.

Reduces handling and transportation costs.

Alcoa Alca Plus plate is light in weight but has the strength needed for many applications, a benefit of aluminum's high lightweight-to-strength ratio. This lightweight characteristic helps reduce handling and transportation costs.

A choice of joining and finishing techniques

Joining Alcoa Alca Plus plate is best accomplished by mechanical fastening with aluminum or stainless steel fasteners, or adhesive bonding. If the plate is to be welded, the metal inert gas (MIG) method is recommended. For detailed information on joining and welding, refer to Technical Data Sheet #3.

Alcoa Alca Plus plate easily responds to a variety of finishing treatments such as grinding, polishing, painting, anodizing, hard coating, electroplating, etching and chemical treatments. Technical Data Sheet #4 has more detailed information.

Readily available

Alcoa Alca Plus aluminum cast machined plate is available from Alcoa Service Centers in standard sizes and thicknesses. They also have the capability of cutting to special sizes and shapes. Call your Service Center representative for the aluminum industry's premium quality cast machined plate . . . Alcoa Alca Plus plate.

Technical Data Sheet #1

Alcoa Alca Plus Aluminum Cast Machined Plate

Physical and Mechanical Properties

Alcoa Alca Plus plate is a general purpose cast tool and jig plate featuring many unique characteristics. It is a high-quality, accurately machined product that has received a thermal stress-relieving treatment to provide dimensional stability during machining. This thermal stress-relieving treatment also imparts thermal recyclability into the Alcoa® Alca Plus™ plate. Typically, it can be heated repeatedly to temperatures as high as 800°F (427°C) and, when cooled, will return to its original dimension with a minimum of distortion, depending upon the extent of machining. Due to the thermal treatment, the hardness will vary considerably with thickness; however, the plate will still retain good machining characteristics. Alcoa Alca Plus plate is of the 7000 series-type alloy and is available in standard thicknesses ranging from 0.25 inch to 4.0 inches (6.35 to 101.60 millimetres). The exact alloy composition is proprietary; however, it has been in use successfully for over 20 years. In addition to its pleasing appearance, Alcoa Alca Plus plate offers good resistance to general corrosion. Since most applications of this precision product are sheltered from atmospheric and industrial environments, no special protective measures are usually required. Special protection should be considered for best performance in prolonged outdoor exposure in heavy industrial or seacoast environments. Alcoa Alca Plus plate accepts a variety of surface finishes.

The following tables list the typical and minimum design properties as well as standard sizes for the product. The tables are in both English and Metric International System of Units (SI).

Properties

Alloy — 7000 Series	Minimum Design	Typical
Tensile Strength, psi*	19,000	26,000
Yield Strength, psi*	11,000	15,000
Elongation in 2", %*		
¼" to 1" Thickness, inclusive	3	7
1¼" to 4" Thickness, inclusive	1.5	5
Brinell Hardness, BHN*		65
Specific Gravity		2.80
Density, lb/cu. in.		0.101
Coefficient of Thermal Expansion (Ave. per °F)		
68-212°F		13.1×10^{-6}
68-392°F		13.6×10^{-6}
Thermal Conductivity, cgs units		0.33
Electrical Conductivity (68°F), % IACS		5
Modulus of Elasticity, psi		10.3×10^{6}
Edge Condition		Sawed

*Mechanical properties obtained using test bars cut from plate; *not* separately cast test bars.

Dimensional Tolerances

Surface Finish (2 Sides) <25 Microinches			
	Plate thickness (inches)	Maximum deviation from flat (inches)*	
Flatness Tolerances	¼ to ⅝ over ⅝	.015 .005	
Thickness Tolerances	Specified plate thickness (inches)	Tolerance from nominal (inches)	
	.250-4.000	±.005	
Width and Length Tolerances	Specified thickness (inches)	Specified width or length (inches)	
	.250-4.000	Up to 10	10 thru 144
	Tolerance (inches)	+3/16 −0	+¼ −0

*When checked on surface plate using 8-ft straight edge.

Standard Sizes*

Standard plate sizes, inches	Nominal weight per plate	Standard plate sizes, inches	Nominal weight per plate	Standard plate sizes, inches	Nominal weight per plate	Standard plate sizes, inches	Nominal weight per plate	Standard plate sizes, inches	Nominal weight per plate
¼ x 48 x 96	115	⅝ x 48 x 96	288	1¼ x 48 x 96	576	2 x 48 x 96	922	3½ x 48 x 96	1613
		48 x 144	432	48 x 144	864	48 x 144	1382	48 x 144	2419
5/16 x 48 x 96	144	60 x 144	540	60 x 144	1080	60 x 144	1728	60 x 144	3024
		¾ x 48 x 96	346	1½ x 48 x 96	691	2½ x 48 x 96	1152		
⅜ x 48 x 96	178	48 x 144	518	48 x 144	1037	48 x 144	1728		
		60 x 144	648	60 x 144	1296	60 x 144	2160		
½ x 48 x 96	230	1 x 48 x 96	461	1¾ x 48 x 96	806	3 x 48 x 96	1382	4 x 48 x 96	1843
48 x 144	346	48 x 144	691	48 x 144	1210	48 x 144	2074	48 x 144	2765
60 x 144	432	60 x 144	869	60 x 144	1512	60 x 144	2592	60 x 144	3456

*Alcoa Alca Plus plate will be cut to any desired width and length and is available in any desired decimal thicknesses and widths up to 60 inches and lengths up to 168 inches on special request.

See reverse side for Tables in Metric International System of Units (SI).

Metric International System of Units (SI)

Properties

Alloy [redacted]	7000 Series Minimum Design	Typical
Tensile Strength, MPa*	131	179
Yield Strength, MPa*	76	103
Elongation in 50.8 mm, %*		
6.35 mm to 25.4 inclusive	3	7
31.75 mm to 101.6 inclusive	1.5	5
Brinell Hardness, BHN*		65
Specific Gravity		2.80
Density, kg/m^3		2800
Coefficient of Thermal Expansion (Ave. per °C)		
20-100 °C		23.6×10^{-6}
20-200 °C		24.5×10^{-6}
Thermal Conductivity, W/M·K		138
Electrical Conductivity (20 °C), % IACS		35
Modulus of Elasticity, MPa		71,000
Edge Condition		Sawed

*Mechanical properties obtained using test bars cut from plate; *not* separately cast test bars.

Dimensional Tolerances

Surface Finish (2 Sides) .64 Micrometre			
	Plate thickness (mm)	Maximum deviation from flat (mm)*	
Flatness Tolerances	6.35 to 15.88 over 15.88	.38 .13	
Thickness Tolerances	Specified plate thickness (mm)	Tolerance from nominal (mm)	
	6.35 - 101.6	±.13	
Width and Length Tolerances	Specified thickness (mm)	Specified width or length (mm)	
	6.35 - 101.6	Up to 254.00	254.01 thru 3657.6
	Tolerance (mm)	+4.76 −0	+6.35 −0

*When checked on surface plate using 2440 mm straight edge.

Standard Sizes

Standard plate sizes, mm	Nominal weight per plate, kg	Standard plate sizes, mm	Nominal weight per plate, kg	Standard plate sizes, mm	Nominal weight per plate, kg
6.35 x 1219.2 x 2438.4	52	19.05 x 1219.2 x 2438.4	157	50.80 x 1219.2 x 2438.4	418
		19.05 x 1219.2 x 3657.6	235	50.80 x 1219.2 x 3657.6	627
		19.05 x 1524.0 x 3657.6	294	50.80 x 1524.0 x 3657.6	784
[redacted] x 1219.2 x 2438.4	65	25.40 x 1219.2 x 2438.4	209	63.50 x 1219.2 x 2438.4	527
		25.40 x 1219.2 x 3657.6	313	63.50 x 1219.2 x 3657.6	784
		25.40 x 1524.0 x 3657.6	394	63.50 x 1524.0 x 3657.6	980
9.52 x 1219.2 x 2438.4	81	31.75 x 1219.2 x 2438.4	261	76.20 x 1219.2 x 2438.4	627
		31.75 x 1219.2 x 3657.6	392	76.20 x 1219.2 x 3657.6	941
		31.75 x 1524.0 x 3657.6	490	76.20 x 1524.0 x 3657.6	1176
12.70 x 1219.2 x 2438.4	104	38.10 x 1219.2 x 2438.4	313	88.90 x 1219.2 x 2438.4	732
12.70 x 1219.2 x 3657.6	157	38.10 x 1219.2 x 3657.6	470	88.90 x 1219.2 x 3657.6	1097
12.70 x 1524.0 x 3657.6	196	38.10 x 1524.0 x 3657.6	588	88.90 x 1524.0 x 3657.6	1372
15.88 x 1219.2 x 2438.4	131	44.45 x 1219.2 x 2438.4	366	101.60 x 1219.2 x 2438.4	836
15.88 x 1219.2 x 3657.6	196	44.45 x 1219.2 x 3657.6	549	101.60 x 1219.2 x 3657.6	1254
15.88 x 1524.0 x 3657.6	245	44.45 x 1524.0 x 3657.6	686	101.60 x 1524.0 x 3657.6	1568

* Alcoa Alca Plus plate will be cut to any desired width and length and is available in any desired decimal thicknesses and widths up to 1524 millimetres and lengths up to 4267.2 millimetres on special request.

Aluminum Company of America
1501 Alcoa Building Pittsburgh, PA 15219

ALCOA

Special alloys, special quality controls create Coilzak's excellent lighting sheet characteristics

Coilzak's reputation for excellence in the lighting industry is a result of the rigid specifications Alcoa maintains during the entire manufacturing process. In order to produce this high-quality product, Alcoa begins with alloys which readily respond to the Alzak finishing process. Special rolling practices and process controls assure a uniformity of gauge, a consistent surface finish and the right mechanical properties. Finishing rolls, ground by Alcoa, impart the desired surface texture so that gloss characteristics will be achieved after finishing.

Alcoa quality control engineers monitor the continuous Alzak processing of Coilzak lighting sheet to determine if reflectance, gloss and anodic oxide coating durability are within specifications. All measurements are quantitatively derived from optical instruments or precise laboratory procedures to minimize subjective judgments.

All Alzak-finished Coilzak lighting sheet meets the following requirements for service, coating weight and stain resistance:

Description of Service	Minimum Coating Weight	Stain Resistance
Mild Interior	5.0 mg/in² (7.8 g/m²)	ASTM B136

Coilzak finish specifications

Designation	Min. Total Reflectivity (%)	Gloss Requirements	
	(Diano TR-I Reflectometer)[2]	Image Clarity D/I (Dori Gon D-47 Glossmeter)[1]	Diffuseness at 15°
Specular	83	70	.05 max.
Semispecular	78	50-75	.12 to .36
		(85° Glossmeter)	
Diffuse	75	35-75	—
		Gloss Requirements	Color Requirements
		Image Clarity D/I Diffuseness (Dori Gon D-47 Glossmeter)	Yellowness Index (%) (ChromoSCAN)[2]
Gold	70	70 —	30-50

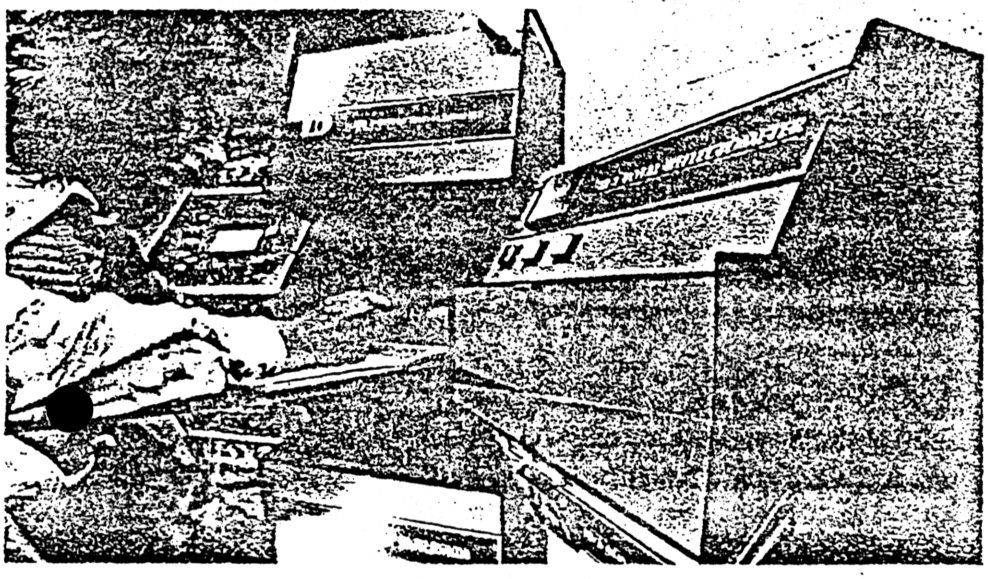
[1]Manufactured by Hunter Associates Laboratory, Fairfax, VA
[2]Manufactured by Diano Corporation, Mansfield, MA

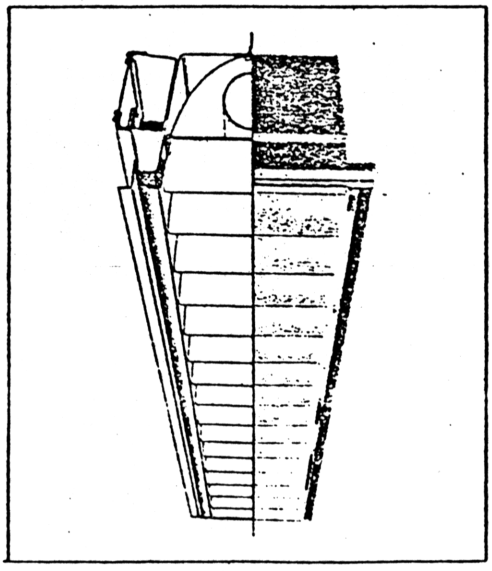
Coilzak lighting sheet—outstanding for use in parabolic luminaires

Parabolic luminaires are esthetically pleasing from the design of the fixture to the type of light they dispel. This is an important consideration where people work, read or shop; where low visual brightness contributes to a comfortable atmosphere.

Fluorescent troffers with parabolic reflectors and louvers of Coilzak lighting sheet have become major factors in achieving quality illumination in modern interior applications. The marriage of Coilzak sheeting material and the parabolic design yields an efficient, batwing light distribution which fosters uniform illumination and minimal direct glare. Louvers featuring the Coilzak semispecular finish blend well with ceilings, eliminating the "dark hole" effect and, with proper lighting design, provide high visual comfort.

Other qualities of Coilzak lighting sheet also complement the effectiveness of the parabolic luminaire. The static-free Alzak finish will not attract dirt, and the downward facing contours afford little opportunity for dirt to accumulate, reducing the light loss factor and maintenance costs compared to a lens-type luminaire. The louvers also create an effective sound baffle to improve conversational privacy in open office arrangements.





The Alzak process

. . . a mark of excellence for 40 years

Both Coilzak and Type I lighting sheet feature Alcoa's Alzak finish, an aluminum finishing process which remains almost unchanged since its original development and is recognized throughout the lighting industry as the quality reflective finish.

The Alzak process uses patented brightening treatments to maximize reflectivity and achieve desirable light reflection characteristics. It also incorporates controlled anodizing procedures to produce a clear, hard anodic oxide surface that gives long service life with minimum maintenance. The features of Alcoa's renowned Alzak finish include:

Resistance to corrosion—Alzak produces an anodic oxide coating on the surface of the sheet which enhances the inherent corrosion-resistant qualities of aluminum.

Resistance to heat — An Alzak finish will not char, burn or give off fumes when heated to 300°-400°F, as do some organic reflector finishes.

Cleanability — The Alzak finish is impervious to dust and dirt in normal environments. For most commercial applications, dusting with a dry cloth is sufficient. Heavier soils or films usually may be removed simply by washing with soap and water. If encrusted dirt accumulates because of neglect, the surface may be cleaned with soap-impregnated scouring pads or an abrasive wax. Strong alkaline or acid cleaners should not be used.

Formability — If the Alzak finish exhibits crazing in areas subject to deformation, the phenomenon has little or no effect on the protective value of the anodic coating or the reflectance capability.

Bend radii — Minimum bend radii for Alcoa lighting sheet are on the order of two or three times the metal thickness, with the larger ratio applicable to the heavier gauges.

Static-free surface—The anodic oxide finish produced by the Alzak process is static-free and will not attract airborne dust and dirt.

Other Coilzak lighting sheet specifications

The following tables show commercial sizes, manufacturing limits and typical mechanical properties of Coilzak lighting sheet.

***Commercial sizes, inches (centimeters)**

Type	24 x 72 (61 x 182.9)	24 x 96 (61 x 243.8)	24 x coil (61 x coil)
Coilzak specular	.025, .032 (.064, .081)	.025, .032 (.064, .081)	.025, .032 (.064, .081)
Coilzak semispecular	.025, .032 (.064, .081)	.025, .032 (.064, .081)	.025, .032 (.064, .081)
Coilzak diffuse	.020, .025 (.051, .064)	.020, .025 (.051, 064)	.020, .025 (.051, .064)

*Note: The sizes listed in the above chart do not necessarily indicate they are stock sizes, but rather the most popular. Consult your nearest Alcoa distributor or sales office for availability.

Commercial manufacturing limits

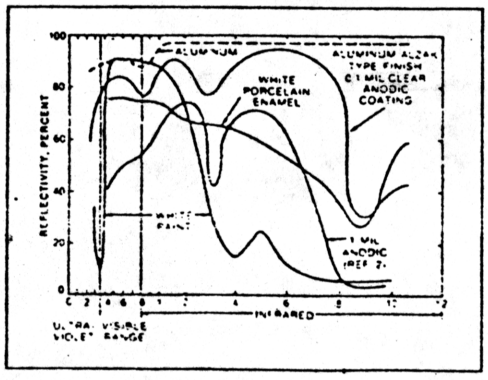
Type	Size, inches (cm) cut-to-length	Coil widths, maximum inches (cm)	Thickness, inches (cm)
Coilzak specular	48 x 144 (122 x 365.8)	48 (122)	.025-.040 (.064-.102)
Coilzak semispecular	48 x 144 (122 x 365.8)	48 (122)	.025-.040 (.064-.102)
Coilzak diffuse	48 x 144 (122 x 365.8)	48 (122)	.020-.050 (.051-.127)

Typical mechanical properties

Type	Tension		Elongation in 2 in. (5.1cm), %1/16-in. (.165-cm thick specimen)
	Ultimate strength, ksi (MPa)	Yield strength, ksi (MPa)	
Coilzak specular	25 (172.25)	22 (151.58)	10
Coilzak semispecular	25 (172.25)	22 (151.58)	9
Coilzak diffuse	25 (172.25)	22 (151.58)	9

- Finish protection for fabrications:
  Coilzak sheet can be supplied with a protective, removable tape. (Removable tape is not recommended where more than 90 days may elapse before removal.)
- Coilzak lighting sheet can only be supplied with one reflective surface.
- Standard packing:
  Coil form—2,500-lb wood skids.
  Cut to length—2,500-lb wood-enclosed skids and paper interleaving.

Typical reflectivity properties of aluminum and other surfaces



Alcoa reflector sheet

Some reflector applications may not permit the use of prefinished Alcoa Alzak lighting sheet, particularly when forming by deep drawing or spinning is required. In such cases and when high-quality finished reflectors are required, Alcoa reflector sheet should be specified for Alzak finishing after fabrication. Contact Alcoa's nearest service center or sales office for availability information.

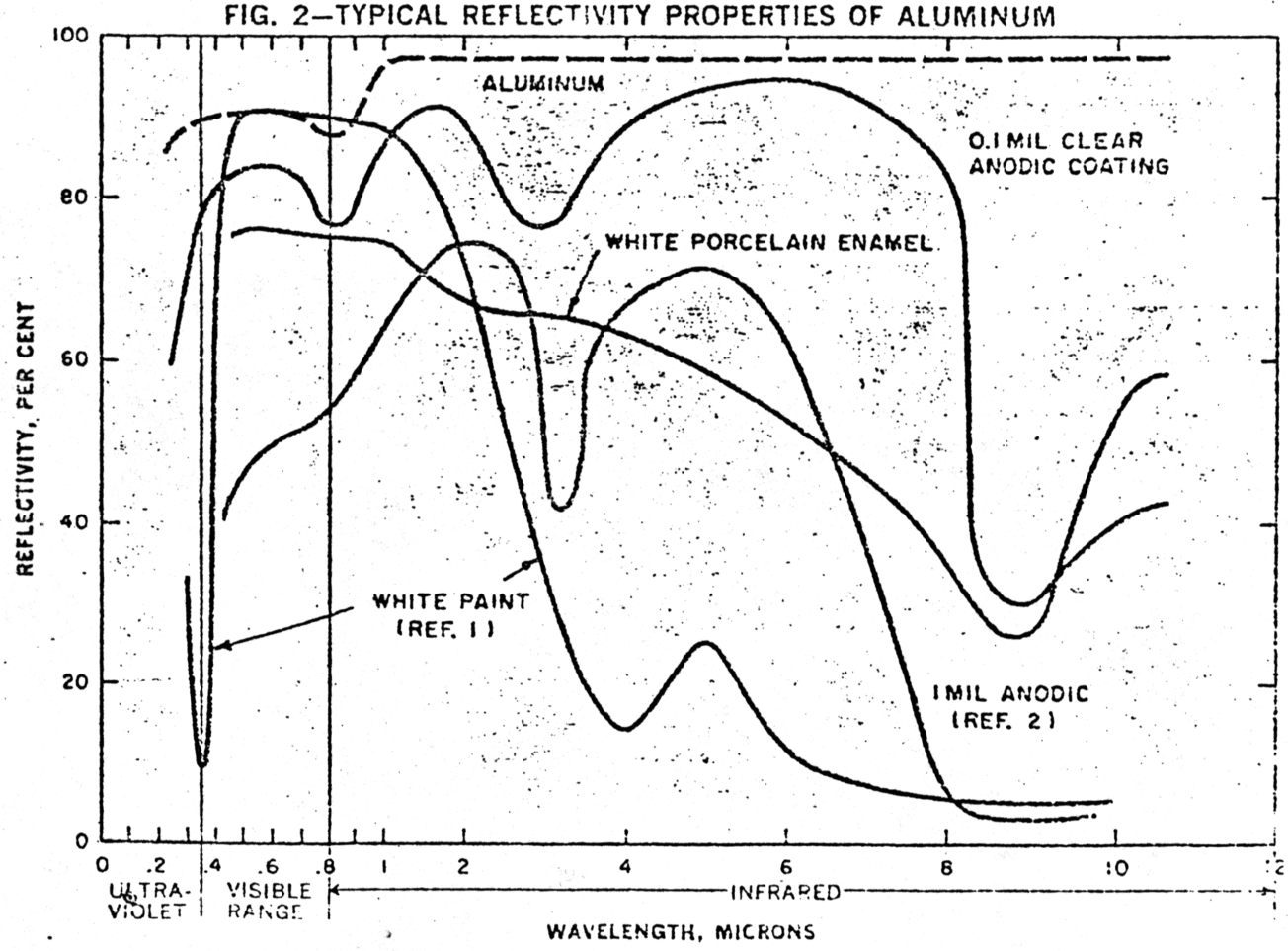
Types of Alzak Reflector Finishes. The following chart lists a variety of service applications for reflectors fabricated with Alzak finishes. These specifications should be used to specify the type of Alzak-Processed Reflectors required. Note that in order to provide permanence of the reflecting surface for some of the more severe applications, it is necessary to increase the thickness of the oxide coating.

TABLE 1—CHARACTERISTICS OF ALZAK REFLECTOR FINISHES

Class	Description of Service	Minimum Weight of Coating, mg per sq in.	Minimum Reflectivity, per cent	
			Specular	Diffuse
MI	Mild interior service (most commercial applications)	5.0	83	75
SI	Medium service (general interior industrial applications and exterior work with a glass bowl or covering protecting the reflector surface)	7.5	82	73
SE	Exterior commercial and industrial service (reflector not protected by glass bowl or covering)	10.0	78	65
SE-A*	Exterior commercial and industrial service (reflector not protected by glass bowl or covering)	10.0	...	75
M	Exterior marine service (reflector surface not protected by glass bowl or covering)	13.0	78	65

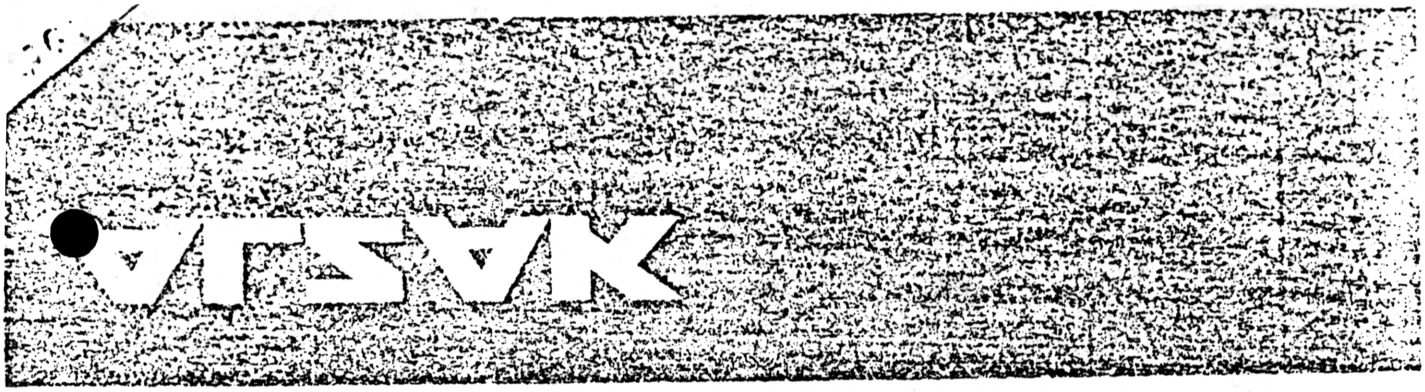
*For special applications where higher diffuse reflectivity is desired.

FIG. 2—TYPICAL REFLECTIVITY PROPERTIES OF ALUMINUM



(1) L. F. Drummeter and E. Goldstein, "Vanguard Emittance Studies at NRC," 1st Symposium. Surface Effects on Spacecraft Materials, Palo Alto, California, 1959.

(2) J. E. Janssen, R. H. Torborg, J. R. Luck and R. N. Schmidt, "Normal Spectral Reflectance of Anodized Coatings on Aluminum, Magnesium, Titanium and Beryllium," ASD Technical Report 61-147, September, 1961.



Advantages of Alzak-Processed Aluminum Reflectors: resistance to abrasion, resistance to corrosion, resistance to heat, ease of cleaning, lightweight for easy installation, variety of reflector shapes, long life, economy, high thermal conductivity, integral protective coating, excellent brightness control, history of successful applications.

SERVICE CHARACTERISTICS OF ALZAK-PROCESSED REFLECTORS: **Reflectors Indoors**—An Alzak reflecting surface is virtually permanent for interior applications. Dust and dirt, although reducing reflectivity, have no deleterious effect on the dry reflector. An Alzak-Processed Reflector can withstand temperatures of about 300°F to 400°F without loss of performance.

Reflectors Outdoors—Performance of an Alzak-Processed Reflector for outdoor applications depends upon the quality of the seal as determined by the type of Alzak Reflector finish. Generally, and providing the coating meets established specifications, durability increases with coating weight. Performance-test data indicated in the table above show measurements of reflectivity after exposure near the seashore and in an industrial area. See Table 2.

TABLE 2—WEATHER RESISTANCE OF ALZAK-PROCESSED REFLECTORS
F[illegible] reflectors, reflecting surface exposed skyward at an angle of 45°

Description of Reflector Surface	Original, No Exposure	Reflectivity—Per Cent* After 3 Years' Exposure at Seashore		After 3 Years' Exposure at New Kensington, Pa.	
		Reflectivity	Loss	Reflectivity	Loss
Specular Surface	85.5	82.5	3.0	82.5	3.0
Specular Surface	84.5	82.5	2.0	82.5	2.0
Specular Surface	84.5	83.0	1.5	82.5	2.0
Diffuse Surface	80.5	77.0	3.5	73.0	7.5
Diffuse Surface	71.5	70.0	1.5	64.5	7.0
Diffuse Surface†	78.5	75.0	3.5	75.0	3.5
Diffuse Surface†	76.0	73.5	2.5	70.5	5.5

*Reflectors cleaned before measuring reflectivity
†Dichromate sealed