



THERMO-LAG 440 FIRE BARRIER SYSTEM
APPLICATION MANUAL FOR
SPRAY GRADE SYSTEM
FOR LPG CONTAINMENT VESSELS

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Table of Contents

<u>Title</u>	<u>Page No.</u>
PREFACE	i
AUDIENCE	i
RELATED PUBLICATIONS AND DOCUMENTS	i
SAFETY PRECAUTIONS	i
NOTES ON INSTALLATION	i
BASIS FOR INSTALLATION PROCEDURES IN THIS GUIDE	i
1.0 GENERAL CONDITIONS	1
1.1 SCOPE	1
1.2 QUALIFICATIONS OF APPLICATORS/RESPONSIBILITIES OF PERSONNEL 1	
1.3 SAFETY PRECAUTIONS	1
1.4 DELIVERY	1
1.5 STORAGE	
1.6 PROTECTION OF ADJACENT SURFACES	1
2.0 MATERIALS	2
2.1 THERMO-LAG PRIMER	2
2.2 THERMO-LAG 440 SUBLIMING COATING	2
2.3 THERMO-LAG TOPCOAT/OR APPROVED EQUAL	2
3.0 EQUIPMENT (Minimum)	2
3.1 PLURAL COMPONENT EQUIPMENT (For Solvent Free and 440-SP)	2
3.1.1 EQUIPMENT STARTUP PROCEDURE	3
3.2 SINGLE COMPONENT EQUIPMENT (For 440-SP only)	4
3.2.1 STARTUP PROCEDURE	5

Table of Contents – Continued

<u>Title</u>		<u>Page No.</u>
4.0	THERMO-LAG 440 APPLICATION PROCEDURES	5
4.1	DEGREASING, BLASTING AND PRIMING	6
4.1.1	DEGREASING	6
4.1.2	LASTING	6
4.1.3	PRIMING	7
5.0	MATERIAL APPLICATION	7
5.1	SCOPE OF WORK	7
5.2	SAMPLE INSTALLATION	7
5.3	SURFACE PREPARATION	7
5.3.1	PRIMING	8
5.3.2	CROSS HATCH ADHESION	8
5.3.3	FIRST THERMO-LAG 440 APPLICATION	8
5.4	THERMO-LAG 440 APPLICATION	9
5.5	COATING THICKNESS	9
5.6	SURFACE FINISH	10
5.7	CURING OF MATERIAL	10
5.8	EQUIPMENT CLEANUP/FLUSHING	10
5.9	TOPCOATING	10
6.0	CLEAN-UP	10

Preface

Audience

We assume that applicators of CARBOLINE products understand the terminology associated with our products and the various application techniques. **The installation of THERMO-LAG 440 Fire Barrier Systems shall be performed only by contractor personnel who have been trained or qualified by CARBOLINE in the installation of the materials.**

Related Publications and Documents

This document occasionally refers to other guides, data sheets, or specifications that may find helpful. Copies are available from CARBOLINE

Other documents or documentation that may be helpful include:

OSHA - Occupational Safety and Health Administration safety rules

National Spray Equipment Manufacturers Association precautions for spraying.

Power tools, hand tools or other mechanical equipment operating procedures

Safety Precautions

The contractor shall follow standard industrial safety practices established for the handling of chemical coatings. This standard shall conform to applicable Occupational Safety and Health Administration and facility owners' safety rules in all respects. Where power tools hand tools, spray equipment, or other mechanical equipment are being used, the proper operating procedures for each tool or piece of equipment, as well as eye, hearing and respiratory protection

THERMO-LAG Bulk Grade Material weighs approximately 10.5 pounds per gallon, therefore, caution should be taken when lifting and moving the material to prevent injury.

Observe the National Spray Equipment Manufacturers Association precautions for spraying. **DO NOT** point spray gun at any part of the human body.

Basis for Installation Procedures in This Guide

Installation of THERMO-LAG 440 Fire Barrier Systems shall be performed only by contractor or contractor personnel who have been trained or qualified by CARBOLINE in the installation of the materials, and who have the equipment and tools required to perform the installation.

Note:

This is a general Application Manual and cannot cover all possible situations that may arise in the field. For technical assistance, CARBOLINE should be contacted and CARBOLINE and the Owner must approve all variances.

1.0 GENERAL CONDITIONS

1.1 SCOPE

This material application guide describes acceptable standards for the application of the THERMO-LAG 440 Subliming Coating System to compressed flammable gas storage vessels.

1.2 QUALIFICATIONS OF APPLICATORS/RESPONSIBILITIES OF PERSONNEL

The application shall be performed by a qualified applicator having training, equipment, and experience. Supervisory or lead personnel involved with the application shall be or have been trained by the Field Service Organization of CARBOLINE, and shall submit written verification of such training. The project manager is responsible for completion of all work to the satisfaction of the client, contractor, and CARBOLINE.

1.3 SAFETY PRECAUTIONS

The applicator shall follow standard industrial hygiene practices for the handling of chemical coatings and shall conform to applicable codes of practice, regulations, and owner safety rules in all respects.

1.4 DELIVERY

The coating materials shall be delivered to the site in original, unopened containers, bearing clearly visible product names, batch number, name of manufacturer, expiration date, and storage instructions.

1.5 STORAGE

The coating materials not in immediate use shall be stored off the ground in a covered area assigned for that purpose by the owner. The materials in storage shall be protected from temperatures above 90°F (32°C) and below 32°F (0°C).

1.6 PROTECTION OF ADJACENT SURFACES

The applicator shall mask off all adjacent areas and equipment from receiving any material overspray during the coating application. Spillage, drips, or overspray should be removed promptly before material has cured.

2.0 MATERIALS

The THERMO-LAG 440 Subliming Coating System consists of the following materials:

2.1 THERMO-LAG PRIMER/OR APPROVED EQUAL

The approved primer system shall be applied to the properly prepared surfaces at the manufacturer's recommended spread rate. The total thickness of the primer system should not exceed 110 microns D.F.T. (4.5 mils D.F.T.). The owner and CARBOLINE shall agree upon any other final dry film thickness in excess of this value.

2.2 THERMO-LAG 440 SUBLIMING COATING

THERMO-LAG 440 is a two component, thermally activated, subliming, epoxy coating. When exposed to flame, the material volatilizes at fixed temperatures; exhibits a volume increase through formation of a multi-cellular matrix; absorbs and blocks heat to protect the substrate material. The thickness of the coating shall conform to the owner's specification.

2.3 THERMO-LAG TOPCOAT/OR APPROVED EQUAL

The topcoat shall be applied at the manufacturer's recommended spread rate. Topcoating, will be carried out in accordance with Client's, paint manufacturer's and CARBOLINE's specification. The site quality inspector will monitor and record weather conditions, paint type and thickness according to the above specification. The maximum allowable time to topcoat the THERMO-LAG 440 is 7 days at 70°F (21°C). If this time is exceeded, the area should be mechanically abraded and solvent wiped prior to topcoating. A topcoat is always required for all applications of THERMO-LAG 440.

3.0 EQUIPMENT (Minimum)

3.1 PLURAL COMPONENT EQUIPMENT (For Solvent Free & 440-SP)

The preferred method of application is by the use of plural component Equipment.

Spray Equipment and Hoses can be purchased from:

Air Tech Spray Systems Inc. (Houston, Texas)
Coverdale Pneumatics Ltd. (Bradford, UK)
Spray Quip (Houston, Texas - U.S.)

It is essential that all equipment be properly utilized and maintained. Poorly maintained equipment may allow the system to go off ratio. We recommend 2 ratio checks per day.

Spray Gun:

Binks 1M Mastic Airless Gun or equivalent

Remove fluid tube and replace with a gun swivel. Install Graco tip adapter. Gun must have a non-diffuser seat

Spray Tips:

Graco Heavy Duty RAC (gray key non-diffuser, non-cateye type)

Size: 0.039" to 0.065" revers-a-clean or equal

Fan Pattern: 6" to 10" (Note: RAC adapter must be used with Graco spray tips on a Binks gun)

Hoses:

Delivery: 3/4" ID minimum (solvent resistant) 50 ft maximum

Whip: 1/2" ID minimum (solvent resistant) 20 ft maximum

3.1.1 EQUIPMENT STARTUP PROCEDURE

A. The pump and all lines shall be clean and free from any contamination.

B Turn off air to main pump. Be sure all pressure is removed from lines. Using the transfer pumps, fill the pumping system with the 440 components. Continue pumping until a steady flow of material is present at the end of the fluid delivery hoses.

C. Turn on all heaters (fluid and line) and adjust temperature of the heaters to 110-130°F (43-61°C) - (140-150°F) (60°C - 66°C) for 100% material). Wait at least 30 minutes for material to heat thoroughly.

D. Although the pump is set for a 1:1 ratio, it is important to check this ratio before beginning any work. Reduce the 3/4" delivery hoses down to 1/8". The length of the 1/8" pipe should be 12" to 15" long.

E. The air pressures needed for properly delivering material may vary from pump to pump, and adjustments may vary from the stated pressures herein.

F. With air still off to the main pump, adjust the air pressure to the "A" component transfer pump to 40 psi. Adjust the air pressure to the "B" component transfer pump to 40 psi. While directing the discharge into separate clean 5 gallon pails, turn the air on to the main pump. Keep pumping until either or both pails are full.

- G. If both 5 gallon pails contain equal volumes, the 1:1 ratio has been achieved. If not, check for restrictions in air or material flow. Repeat above procedure. If ratio is still not correct, inspect pump packing and replace if needed. Repeat the above procedure.

NOTE: If the transfer pump pressure is adjusted too high, it will over pressure the proportioning unit, and affect your ratio.

- H. When the proper ratio is obtained, remove the 1/8" pipes and replace the mixing manifold. Attach the static mixer, whip hose and gun.

- I. Apply enough pressure to the main pump to achieve a proper fan pattern. Apply material in accordance with the procedures recommended herein.

NOTE: A minimum of one ratio check per shift is required. An additional ratio check is required before starting a pump that has been repaired.

3.2 SINGLE COMPONENT EQUIPMENT (For 440 SP only)

Minimum equipment required to apply THERMO-LAG 440 SP includes:

Spray Equipment

Must use a 45:1 King, 67:1 Premier or 74:1 Premier with a minimum 3/4" outlet on high pressure side

A hopper feed is required

Compressor: Large enough to run pump and deliver consistent air supply

Spray Gun:

Binks 1M Mastic Airless Gun or equivalent

Remove fluid tube - replace with a gun swivel

Install a Graco tip adapter. Gun must have a non-diffuser seat

Spray Tips

Graco Heavy Duty RAC (gray key non-diffuser, non-cateye type)

Size: 0.039" to 0.065" revers-a-clean or equal

Fan Pattern: 6" to 10"

Note: (RAC adapter must be used with Graco spray tips on a Binks gun)

Hoses

Delivery: 3/4" ID minimum (solvent resistant) 50-ft maximum

Whip: 1/2" ID minimum (solvent resistant) 20-ft maximum

Air Requirements

40 - 100 cfm @ 100 psi per unit. Use moisture and oil traps. Ram Feed recommended. *Reduce up to 3% if necessary with Toluene.

Thinners

Use Toluene or CARBOLINE Thinner #19. Reduce up to 3% if necessary.

*Any other thinners must be pre-approved by CARBOLINE.

3.2.1 STARTUP PROCEDURE

It is important that the pump and all lines are clean and free from any contamination. Stir contents of each container (Part A and Part B), separately making sure that no pigment remains on the bottom of the pail. Pour a measured amount of Part B into a container large enough to hold both pre-measured components. Add an equal volume of Part A to Part B while under agitation. If the THERMO-LAG was supplied in premeasured amounts (i.e. Half kits), add the part B from the 3 gallon pail to the short filled 5 gallon pail of part A. Continue agitation until the two components are thoroughly mixed. Thin with recommended thinners only if necessary (maximum of 3%). Thinning will decrease the amount of material which can be applied in one coat and decrease the rate of cure. Do not mix more material than can be sprayed in 30 to 60 minutes. Dump Material into hopper. Remove spray gun from end of hose. Turn pump pressure up only high enough to move material to the end of the delivery line. Turn off air and replace spray gun. Increase air pressure until appropriate fan pattern is achieved. Apply material in accordance with the procedures detailed herein. Insure that the side walls of the hopper are continuously wiped clean between kits.

4.0 THERMO-LAG 440 APPLICATION PROCEDURES

The applicator shall apply the THERMO-LAG 440 Subliming Coating over a properly cured primer. The material shall be applied in as many passes required to provide the desired wet film thickness. It is the recommendation of CARBOLINE that a thickness of no greater than 6.5mm (or .25") be applied in a single coat. When it is not possible to apply the total thickness in a single coat, allow applied material to cure sufficiently to support the weight of subsequent coats. The thickness that can be safely applied in a single coat will depend on the temperature, humidity, applicator technique, etc., and must be determined by trial on the job. The time between coats is largely dependent upon ambient temperatures and in general the following table should be used:

Overcoating Times Between THERMO-LAG 440 Coats

<u>Temperature (°F/°C)</u>	<u>Time (Mins)</u>
50°F (10°C)	140
77°F (25°C)	110
85°F (29°C)	75
95°F (35°C)	60
110°F (43°C)	60

The applicator shall take frequent wet thickness measurements of the coating during application, using a penetrating measuring device, to ensure that the coating is being applied uniformly and at the required wet film thickness. These wet film thickness checks shall be made at least once every five (5) square meters of coated surface area. Care shall be exercised to keep the spray gun fan pattern at an angle of 90 degrees to the sprayed surface, and at 12" to 18" away from the surface. A brush and/or roller can be used to improve the surface quality. Please read the THERMO-LAG 440 Subliming Coating product data sheet before application commences.

Excessive build-up of coating material in angle areas can be removed or leveled by rolling the surface with a sponge roller or short napped mohair roller.

4.1 DEGREASING, BLASTING AND PRIMING

4.1.1 DEGREASING

All surfaces shall be cleaned and degreased prior to grit blasting the steel. The method to be used can either be hot water wash, steam cleaning, or cleaners that are manufactured for this purpose. Solvents should not be used for this purpose as they can smear and spread the oils and grease rather than remove it. When selecting a cleaning method the primer manufacturer's recommendations must be adhered to.

4.1.2 BLASTING

All blasting abrasive shall be dry, clean and free from contaminants. Where metallic shot or grit is used, it must be continuously checked and sieved to remove fines and contaminants. The compressed air shall be free from water, oil, dirt, etc. Wet blasting shall not be used without the permission of CARBOLINE.

All steel surfaces shall be blasted to a Sa 2 Swedish Standard SIS 05 5900-1967 (or subsequent edition) with a minimum anchor pattern of 0.002" (50 microns). The equivalent U.S. Standard is SSPC – SP6. When a primer is used always consult the primer manufacturer's recommendations. Prime the steel surface within 4 hours after blasting to the primer manufacturer's recommended spread rates.

4.1.3 PRIMING

Only primers systems tested and approved by CARBOLINE shall be used beneath THERMO-LAG 440. The Approved Primer shall be applied following good painting practices. All surface temperatures shall be above 50°F (10°C). The surface temperature must be at least 5° F (3°C) above the dew point. At all times, the primer manufacturer's recommendations must be followed. Primer system thickness must not exceed the value detailed in section 2.1 of this manual.

5.0 MATERIAL APPLICATION

5.1 SCOPE OF WORK

The installation procedure consists of blasting, priming, spraying the THERMOLAG 440, finishing the surface of the THERMO-LAG 440 (See 5.2 Sample Installation) and clean up.

5.2 SAMPLE INSTALLATION

Prior to actual production work, a sample test area will be prepared following all specified procedures. Representatives of the client, applicator, architect and any others having a vested interest in the installation, will then approve this sample. Final acceptance of the site sample test area shall be by the owner.

5.3 SURFACE PREPARATION

All blasting abrasive shall be dry, clean and free from contaminants. Where metallic shot or grit is used, it must be continuously checked and sieved to remove fines and contaminants. The compressed air shall be free from water, oil, dirt, etc. Special precautions need to be taken.

All steel surfaces shall be blasted to a Sa 2 Swedish Standard SIS 05 5900-1967 (or subsequent edition) with a minimum anchor pattern of 0.002" (50 microns).

The equivalent U.S. Standard is SSPC – SP6. When a primer is used always consult the primer manufacturer's recommendations. Prime the steel surface within 4 hours after blasting to the primer manufacturer's recommended spread rates.

5.3.1 PRIMING

Only primers systems tested and approved by CARBOLINE shall be used beneath THERMO-LAG 440. The Approved Primer shall be applied following good painting practices. All surface temperatures shall be above 50°F (10°C). The surface temperature must be at least 5°F (3°C) above the dew point. At all times, the primer manufacturer's recommendations must be followed.

5.3.2 CROSS HATCH ADHESION

After the primer has adequately cured, perform a cross-hatch adhesion test to assure proper adhesion between the primer and steel substrate. The criteria for acceptance of adhesion shall be ASTM D3359 Method A. (Scale 4A). At least one cross hatch adhesion test per each ten (10) square meters of coated steel surface will be carried out. CARBOLINE and the Owner shall approve any variance in frequency of testing.

5.3.3 FIRST THERMO-LAG 440 APPLICATION

THERMO-LAG 440 shall be applied in good weather, following good painting practices. In general, the substrate and ambient temperature shall be no less than 41°F (5°C), and 3°C above dew point. The humidity shall be less than 85% and the temperature shall be 5°F (3°C) above the dew point. Any deviation shall be subject to approval by CARBOLINE.

The Applicator shall apply the THERMO-LAG 440 Subliming Coating over a properly cured primer. The material shall be applied in as many passes required to provide the required wet film thickness. A thickness of no greater than 6.5mm (or .25") shall be applied in a single coat. When it is not possible to apply the total thickness in a single coat, allow applied material to cure sufficiently to support the weight of subsequent coats. The thickness that can be safely applied in a single coat will depend on the temperature, humidity, applicator technique, etc., and must be determined by trial on the job. The time between coats is largely dependent upon ambient temperatures and in general the following table should be used:

Typical Overcoating Times Between THERMO-LAG 440 Coats

<u>Temperature (°F/°C)</u>	<u>Time (Mins)</u>	<u>Max. Time (Hrs.)</u>
50°F (10°C)	140	72
77°F (25°C)	110	72
85°F (29°C)	75	48
95°F (35°C)	60	48
110°F (43°C)	60	24

The Applicator shall take frequent wet thickness measurements of the coating during application, using a penetrating measuring device, to ensure that the coating is being applied uniformly and at the required wet film thickness. These wet film thickness checks shall be made at least once every five (5) square meters of coated surface area.

Care shall be exercised to keep the spray gun fan pattern at an angle of 90 degrees to the sprayable surface, and at 12" (305mm) to 18" (457.2mm) away from the surface. A brush and/or roller can be used to improve the surface quality. Please read the THERMO-LAG 440 Subliming Coating product data sheet before application commences.

Excessive build-up of coating material in angle areas can be removed or leveled by rolling the surface with a sponge roller or short napped mohair roller.

5.4 CONTINUED THERMO-LAG 440 APPLICATION

When the specified thickness cannot be applied in one coat, overcoating shall be done within 72 hours of the prior coat. If this time is exceeded, the surface must be sweep blasted and cleaned with a solvent to insure proper bonding between the two coats. The use of a solvent must be approved by the Owner.

5.5 COATING THICKNESS

The final coating thickness will be specified in project drawings and owners specifications. This thickness is normally based on an average thickness, however, in some projects, a minimum thickness may be specified. When an average thickness is specified, the minimum acceptable thickness for any one point should not be less than 85% of the listed thickness, or .060" (1.5mm), whichever yields the lesser thickness. Multiple readings must be taken and the average thickness of these measurements must equal the rated listing. The final decision on thickness criteria is at the sole discretion of the owner.

After the coating has cured, use a magnetic thickness gauge to ensure the minimum thickness requirements have been met. Substandard thickness areas shall be built up to specified thickness by the application of additional THERMOLAG 440 material to those areas (see 5.4). An alternate method of thickness measurement is drilling a pilot hole and using a penetrating measuring device. It is required to fill all probe holes with THERMO-LAG 440 after measurements have been taken. THERMO-LAG 440 material thicknesses shall be in accord with owners or certifying authority requirements.

5.6 SURFACE FINISH

The finished surface shall conform to the standards as delineated in section 5.2 of this manual.

5.7 CURING OF MATERIAL

Ambient conditions and material thickness will affect cure time.

5.8 EQUIPMENT CLEANUP/FLUSHING

Clean up at the end of the spray period can be achieved using hot water (150°F) (66°C) for a plural component and Toluene/Thinner #19 for single component. (Consult CARBOLINE Technical Service) The Owner, if used, must approve the cleaning solvent. Be advised that the spray gun, static mixer and block assembly should be hand cleaned.

5.9 TOPCOATING

Topcoating will be carried out in accordance with the clients, paint manufacturers and CARBOLINE's specification. The site quality inspector will monitor and record weather conditions, paint type and thickness according to above specification. The maximum allowable time to topcoat the THERMO-LAG 440 is 7 days at 70°F (21°C). If this time is exceeded, the area should be mechanically abraded and solvent wiped prior to topcoating. If ambient temperatures fall below 70°F (21°C), the topcoating time may be extended. (Consult CARBOLINE Technical Service)

6.0 CLEAN-UP

A clean and orderly condition shall be maintained in the application area. Following the application, all overspray, debris, and equipment shall be removed and the area left in a condition acceptable to the owner and main contractor.