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NEW YORK STATE DEPARTMENT OF TRANSPORTATION

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APPROVED: R. H. Edwards, D.C.E. Fac. Design/L. H. Moore, D.C.E., Tech. Serv

An updated version of the Pavement Restoration Techniques listing is attached.

The purpose of this listing is to provide a catalog of current treatments along with some useful background information. Designers should use this information when considering various alternates for pavement restoration projects.

Treatments in the listing are underlined if they are considered to be standard treatments. Treatments that are not underlined are considered experimental or proprietary and their use must be explained and justified as noted in the attached introduction.

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# PAVEMENT RESTORATION TECHNIQUES: AN UPDATE

DECEMBER 1982

(REVISED MARCH 1984)

TECHNICAL SERVICES DIVISION
NEW YORK STATE DEPARTMENT OF TRANSPORTATION
STATE CAMPUS, ALBANY, NEW YORK 12232

# PAVEMENT RESTORATION TECHNIQUES: AN UPDATE

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# PAVEMENT RESTORATION TECHNIQUES: AN UPDATE

## INTRODUCTION

This updates the report entitled PAVEMENT RESTORATION TECHNIQUES which was published by the Technical Services Division in December 1982. It is a summary guide of state-of-the-art techniques and treatments used for pavement maintenance, rehabilitation and reconstruction.

Some treatments described in this report can be accomplished with standard "shelf" items, while others require the use of items considered by the Department to be either experimental or proprietary. It is expected that many of these experimental and proprietary items will become standard after more experience is gained with their use and/or additional products are developed and placed on the market. In the meantime, however, the use of these items is restricted and therefore requires justification in accordance with Section 21.03 of the Highway Design Manual. As part of this justification a summary of the condition of the pavement, the alternate treatments considered and the treatment selected should be included in the explanation of why the Special Specification is required. For the convenience of the reader, treatments <u>not</u> requiring justification if used as indicated have been underlined in this report.

Portland cement concrete (PCCP) and asphalt concrete (ACP) pavements require various treatments to maintain, rehabilitate, or reconstruct the pavement depending upon the condition of the pavement and the level of service desired. Many standard types of treatments are currently in use and many more are in various stages of development. This summary is a listing of treatments based on the Department's experience to date. The purpose of this listing is to provide a "catalog" of treatments along with some useful background information.

The selection of proper treatment(s) by the "designer" to maintain or improve a pavement can be made effectively only after knowing the condition of the existing pavement. Therefore, it is recommended that a pavement inspection be completed and a condition report be available to the designer for selecting the proper treatment(s) for the pavement condition.

Information presented on PCC and AC pavements includes 1) treatment, including special specification numbers; 2) application; 3) cost data; and 4) remarks, including experience information. For PCC pavements overlaid with asphalt concrete, the pavement can be generally considered as an AC pavement. However, special considerations may have to be made.

Cost data provided in the listing is based on current statewide average bid prices or the prices available for new treatments from experimental projects. Cost assumptions should be reviewed for each project.

Technical Services Division personnel are available to provide additional information on any listed treatment(s).

## PORTLAND CEMENT CONCRETE PAVEMENT (PCCP) TREATMENTS

| TREATMENT | APPLICATION | COST | REMARKS |
|---|---|---|---|
| RESEALING TRANSVERSE JOINTS IN PCC PAVEMENT ITEM 18502.442001 | Use on resealing projects where original preformed neoprene sealers have failed and faulting and vertical slab movements are minimal. | $2.00/LF (1983 estimated price) | Several years experience with PVC. Three years experience with silicone on I-84, Region 8. |
| RESEALING TRANSVERSE JOINTS IN PCC PAVEMENT ITEM 18502.442002 | Use on resealing projects where original preformed neoprene sealers have failed and vertical slab movement, loss of load transfer and/or faulting is evident at joints less than 1 3/4 inches wide. | | Silicon liquid sealers are placed in properly cleaned and sized joints. Sawing joint to proper size may be necessary. Details in specification. Silicon is a proprietary material and a justification for its use is required. |
| RESEALING LONGITUDINAL JOINTS IN PCC PAVEMENT ITEM 18502.4425 | Use on resealing projects where original preformed neoprene sealers have failed. Resealing protects tiebars, prevents incompressible infiltration, and prevents water from weakening subgrade. | $1.50/LF(1983) | |
| DIAMOND GRINDING AND TEXTURING OF PCC PAVEMENT ITEM 08502.50 | Use where faulted joints have become objectionable, greater than 3/16". | $7/SY (1981) | Three years experience to date on I-84 in Region 8. |
| This item consists of diamond grinding the entire lane(s) to remove faulted joints. | Wheeltrack ruts can be removed and pavement cross slope changed. Pavement friction is increased due to texture left after grinding. | | With truck traffic at the rate of 1900-2600 trucks/day (8000-12000 vehicles/day) faulting has recurred on I-84 at approximately 1/16" per year. Pavement slabs will continue to fault following grinding unless load transfer is restored. |

## PORTLAND CEMENT CONCRETE PAVEMENT (PCCP) TREATMENTS

| TREATMENT | APPLICATION | COST | REMARKS |
|---|---|---|---|
| PARTIAL DIAMOND GRINDING AND TEXTURING OF CONCRETE PAVEMENT<br>ITEM 08502.5001 | Grinding confined to the faulted joint, 2 foot length ground for each 1/16" of faulting. | $7/SY (1983) | Rideability is being evaluated. |
| PRESSURE RELIEF JOINTS IN EXISTING PCC PAVEMENT<br>ITEM 15502.4598 | Use to protect bridges or prevent blowups in areas where the frequency of rigid pavement blowups is unusually and predictably high. | $46/LF (1982) | This item has become a standard treatment to prevent damage to structures and to stabilize pavements prior to overlaying. See EI 82-65 |
| The full pavement width is removed for a 5 to 6 foot length, and replaced with dense graded asphalt concrete. | Will prevent future blowups and will stabilize a pavement before other restoration such as overlaying.<br>Place at ends of structures and at 1000' to 1500' intervals if a PCCP needs stress relief prior to overlaying. | | |
| FURNISH AND PLACE RAPID SETTING POLYMER CONCRETE FOR PCC PAVEMENT REPAIRS<br>ITEM 10502.0711 | Use for spall repair. Large spalls and potholes are repaired using aggregate to extend the yield of the polymer. | $54.00/per 30# bag<br><br>Extended with 22.5# aggregate yields 0.4 C.F. | Three years experience in Region 10 shows good bond and durability. The designer should consider other alternates for large spalls, where a substantial volume of deteriorated concrete is to be removed and replaced, as polymer concrete is expensive. |
| SURFACE PREPARATION FOR POLYMER CONCRETE PLACEMENT<br>ITEM 10502.0710 | | $9.60/SF for preparation. (1982) | |
| Polymer concrete is placed in properly prepared voids. Compressive strength of 5000 psi is attained after 1 hour. | | | |

# PORTLAND CEMENT CONCRETE PAVEMENT (PCCP) TREATMENTS

| TREATMENT | APPLICATION | COST | REMARKS |
|---|---|---|---|
| RAPID SETTING MAGNESIUM PHOSPHATE CONCRETE PAVEMENT REPAIRS<br>ITEM 10502.0703 | Use for spall repair. Aggregate is used to extend yield for large voids. | $165/per 50# bag surface preparation included (1980) | Three years experience in Region 10 shows good bond and durability. |
| Magnesium Phosphate based material is placed in properly prepared voids. Compressive strength of 3500 psi is attained after 1 hour. | | Extended with 30# aggregate yield 0.6 C.F. | The designer should consider other alternates for large spalls, where a substantial volume of deteriorated concrete is to be removed and replaced as magnesium phosphate concrete is expensive. |
| CORRUGATED POLYETHYLENE UNDERDRAIN PIPE, 4 INCH DIAMETER.<br>ITEM 18605.060403 | Use to provide drainage at edge of pavement. Contact Regional Soils Engineer for assistance. | $1.91/LF (1982) Excavation and backfill paid separately. | This item has become a standard treatment on new construction and on restorations. |
| CRUSHED STONE WEEP<br>Item 08203.9902 | Use to provide drainage at edge of pavement. Contact Regional Soils Engineer for assistance. | $15.00/LF (1983) Includes excavation and backfill. | Used on steep grades or at sags of vertical curves. |
| CEMENT CONCRETE FOR PAVEMENT REPAIRS<br>ITEM 10502.6021 | Use for full depth removal and replacement of concrete pavement segments when slabs cannot be closed to traffic for more than 6 hours and where the scope of the project calls for retaining the concrete surface. | $300/CY (1983) | Used in Region 10 (1983) |
| After removal, a calcium chloride accelerated portland cement concrete is mixed on site and placed in the prepared void. | The existing pavement is removed, steel dowels are grouted in holes drilled in the existing slabs, an expansion joint load transfer device placed, and the accelerated concrete placed. | Sawcutting, excavation, load transfer devices are paid for separately. | |

## PORTLAND CEMENT CONCRETE PAVEMENT (PCCP) TREATMENTS

| TREATMENT | APPLICATION | COST | REMARKS |
|---|---|---|---|
| INVERTED T PAVEMENT REPAIR USING CALCIUM CHLORIDE ACCELERATED CONCRETE<br>ITEM 10502.6002 | The existing pavement is undercut, an inverted T section of reinforced accelerated concrete provides load transfer. | $25/SF (1983) Sawcutting and joint sealing are paid for separately. | Two years experience in Region 10 shows good load transfer performance and durability. |
| U OF I RETROFIT LOAD TRANSFER DEVICES FOR TRANSVERSE JOINTS IN PCC PAVEMENT<br>ITEM 18502.3402<br><br>Devices developed by the University of Illinois are installed in core holes and bonded in place with polymer concrete. Three or four are used per joint. | Use to establish load transfer at transverse joints. | $75/EA. (installed) | Materials Bureau installed retrofit LTD in 4 joints on I-84 in Region 8. Performing well after 14 months.<br><br>Experimental contract built in 1983 on I-84 in Region 8. |
| DOWEL RETROFIT LOAD TRANSFER DEVICES FOR TRANSVERSE JOINTS IN PCC PAVEMENT<br>ITEM 18502.3401<br><br>Standard epoxy coated dowels are placed in sawcut slots across joint and bonded in place with polymer concrete. Four and eight are used per 12 foot width of faulted joint. | Use to establish load transfer at transverse joints. | $85/EA. (installed) | Experimental contract built in 1983 on I-84 in Region 8. |

## PORTLAND CEMENT CONCRETE PAVEMENT (PCCP) TREATMENTS

| TREATMENT | APPLICATION | COST | REMARKS |
|---|---|---|---|
| **BREAKING AND SEATING EXISTING CONCRETE PAVEMENT**<br>ITEM 18203.99<br><br>A drop hammer and 50 ton roller are used to break and seat the pavement. | Use to prevent transverse joint reflection cracks through an asphalt overlay.<br><br>Use where the PCCP is deteriorated to the point that the only other feasible alternative is reconstruction. A broken and seated PCCP should be overlayed with a minimum of 5" of AC. | $2692 per lane mile (1982) | A new break pattern will be tried experimentally in 1984 on mesh reinforced PCCP. |
| SUBSEALING PCC PAVEMENT<br>ITEM 08631.0401<br><br>A cement and pozzolan (fly ash) slurry is pumped beneath the pavement to fill voids. | Use to fill voids under pavement slabs.<br><br>Consult Regional Soils Engineer for assistance. | $130-$256/bag (1983) | This item used experimentally in 1983 on I-84.<br><br>Experience after two years on I-84 is inconclusive. Pavement faulting is recurring. |
| FURNISHING EQUIPMENT FOR SUBSEALING CONCRETE PAVEMENT.<br>ITEM 06631.05 | | $4200-$15000 LS (1983) | |
| DRILLING HOLES FOR LIME CEMENT SUBSEALING CONCRETE PAVEMENT.<br>ITEM 08631.02 | | $7.50-$23.00/hole (1983) | |
| PCC PAVEMENT JACKING.<br><br>No current specification. A lime cement grout under pressure is used to lift slabs. | Use to lift pavement slabs to original position. | Not available | Experience has been poor. Contract trials have not been successful. Not recommended. |

## PORTLAND CEMENT CONCRETE PAVEMENT (PCCP) TREATMENTS

| TREATMENT | APPLICATION | COST | REMARKS |
|---|---|---|---|
| GROOVE PCC PAVEMENT<br>ITEM 47GX | Used to reduce wet weather hydroplaning accidents. | No current costs available | Research has shown wet weather accidents are reduced after grooving providing that the concrete pavement has adequate micro texture on the surface. Used routinely by Maintenance for spot corrections. |
| SEALING CRACKS IN PCC PAVEMENT<br>ITEM 08502.35<br><br>After routing and cleaning, cracks are filled with a rubberized asphalt. | Use on resealing contracts for sealing slab cracks greater than 1/8 inch wide. | No costs available estimate $1.50/LF | First contract use was in 1983 on I-84.<br><br>Maintenance is using both asphalt and rubberized asphalt crack sealers. |
| BONDED PCC PAVEMENT OVERLAY.<br>ITEM 03502.07<br><br>A Class D concrete, three inches thick is bonded to a prepared surface with a cement-sand grout. | Use for overlaying PCC pavement. (Can also be used as inlay.) Amount of existing distress such as cracking, spalling will determine service life.<br><br>Contact Materials Bureau for details. | $8.75/SY (1981)<br><br>Associated Items such as scarification, strengthening joints, pressure relief, and new joint sealing brought total price for Region 3 project to $16.17/SY. | 18 lane miles of Interstate was overlaid in 1981 in Region 3.<br><br>This project is being monitored for cost effectiveness.<br><br>Performance is good after two years.<br><br>Inlays have been constructed in Regions 1 and 2. Both show good performance after 4 years. |

## PORTLAND CEMENT CONCRETE PAVEMENT (PCCP) TREATMENTS

| TREATMENT | APPLICATION | COST | REMARKS |
|---|---|---|---|
| PARTIAL BONDED PCC OVERLAY. A minimum 6 inch thick mesh reinforced concrete pavement with load transfer is constructed on the existing pavement. No deliberate attempt is made to achieve bond. | Used to overlay a moderately deteriorated pavement. Amount of existing distress will determine service life. Contact Materials Bureau for details. | Calculate for individual project | No recent experience in N.Y. |
| UNBONDED PCC PAVEMENT OVERLAY. A minimum 6 inch thick mesh reinforced concrete pavement with load transfer is constructed over a bond breaker (1" thick asphalt concrete) over the existing pavement. | Used to overlay an extensively deteriorated pavement. Contact Materials Bureau for details. | Calculate for individual project. | No recent experience in N.Y. Bond breaker is used to prevent reflection cracks. Service life of new pavement could be expected. |
| ASPHALT OVERLAY OVER PCCP. 2 1/2 inch minimum thickness. Various Standard Items. A 1 1/2 inch thickness of Dense Binder and 1 inch thickness of Asphalt Top Course is placed on a patched, sealed, tack coated and leveled pavement. Truing and Leveling course thickness variable. | Used to overlay a moderately deteriorated PCC pavement. | ITEM 403.13 BINDER COURSE. (1982, 3) $31.40/Ton<br>ITEM 403.17 TYPE 6F TOP COURSE (1982, 3) $30.99/Ton | Service life depends on conditions overlayed. Seven year life before overlaying is current programming standard.<br>Patching, joint sealing and tack coat prices will depend on individual project size. |

## PORTLAND CEMENT CONCRETE PAVEMENT (PCCP) TREATMENTS

| TREATMENT | APPLICATION | COST | REMARKS |
|---|---|---|---|
| SAWING AND SEALING OF ASPHALT CONCRETE OVERLAY ITEM 18403.25<br><br>Reservoirs are sawcut and sealed over existing joints to control and seal reflection cracks. | Used for first time overlays where joints are in generally good condition to insure straight predictable cracks. | $1.90/LF (1981) Region 4 project. | Service life will be extended as reflection cracking which leads to pot holes is controlled and sealed. See EI 82-62. |
| ASPHALT OVERLAY FOR STRUCTURAL RESTORATION OF PCCP. Various Standard Items.<br><br>Dense graded asphalt concrete mixes are placed on a patched, sealed, tack coated, shimmed and leveled pavement. | Used to overlay an extensively deteriorated pavement.<br><br>Contact Soils and Materials Bureaus for assistance in thickness design and corrections necessary before overlaying. | ITEM 403.11 BASE COURSE (1982, 3) $30.15/Ton<br><br>ITEM 403.13 BINDER COURSE (1982, 3) $31.40/Ton<br><br>ITEM 403.17 TYPE 6F TOP COURSE (1982, 3) $30.99/Ton<br><br>Patching, joint sealing, tack coat, shim course, T&L prices will depend on individual project size. | Service life depends on existing conditions and thickness of overlay.<br><br>Sawing and Sealing of the Asphalt Concrete Overlay will extend service life if conditions are favorable for its use. |

## PORTLAND CEMENT CONCRETE PAVEMENT (PCCP) TREATMENTS

| TREATMENT | APPLICATION | COST | REMARKS |
|---|---|---|---|
| FULL DEPTH PCCP SLAB REPLACEMENT WITH DENSE GRADED ASPHALT CONCRETE BASE OR BINDER AND TOP ITEM 403.11 or 403.13 & 403.17.<br><br>Structurally unsound PCC pavement slabs are replaced with new dense bituminous concrete before being overlayed with AC. | Used where individual pavement slabs have failed because of localized weakened subbases. | $31/Ton (1982) | The cause of the problem must be corrected for the treatment to be cost effective. Performance has been satisfactory on I-87 and I-81 after five and three years respectively. Often used in conjunction with asphalt concrete overlays. |
| CEMENT CONCRETE PAVEMENT, REINFORCED, CLASS F ITEM 502.05<br><br>Structurally unsound PCC pavement slabs are replaced with new reinforced PCC pavement slabs. | Used where individual pavement slabs have failed because of localized weakened subbases.<br><br>Contact Soils and Materials Bureaus for assistance. | $115/CY (1982) Class F Concrete<br><br>Associated items such as unclassified excavation, subbase replacement, mesh reinforcement, joint supports, ties and construction and sealing joints must be added. Cost of these items will vary depending on the quantities involved. | The cause of the problem must be corrected for the treatment to be cost effective. |
| PCCP RECONSTRUCTION. STANDARD ITEMS<br><br>Remove and replace entire pavement | Use for complete replacement of existing pavement, in kind or as flexible pavement. | Calculate for individual project. | Service life of new pavement will be achieved. |

## ASPHALT CONCRETE PAVEMENT (ACP) TREATMENTS

| TREATMENT | APPLICATION | COST | REMARKS |
|---|---|---|---|
| AC OVERLAY - STANDARD ITEMS | Structural<br>Single or multiple layer(s) of sufficient thickness to provide adequate increase in total pavement thickness for design traffic. | See Bid Prices | |
| | Ride/Preventive maintenance<br>Single or multiple layer(s) to restore acceptable ride, cover minor cracking, raveling, etc. | | |
| | Pavement Friction<br>ITEM 403.20, TYPE 9F TOP COURSE should be used where a greater than normal friction number is desirable. | | |
| | Truing and Leveling<br>Single or multiple layer(s) or various thickness needed to obtain proper grade and cross-slope (Item 403.21). | | Wheel path ruts should be filled with a shim course (Item 403.15).<br><br>Pavement milling may be a cost effective alternative to truing and leveling courses to achieve proper grade on cross slope. |
| AC PAVEMENT REPLACEMENT AND/OR RECONSTRUCTION | Full Depth patches, replacement of short sections, complete pavement reconstruction. Multiple layers of sufficient thickness to provide adequate total pavement thickness for design traffic. | See Bid Prices | |

## ASPHALT CONCRETE PAVEMENT (ACP) TREATMENTS

| TREATMENT | APPLICATION | COST | REMARKS |
|---|---|---|---|
| ASPHALT CONCRETE MIXTURES WITH MODIFIERS | Special situations. | | |
| Synthetic Fibers | Increase in tensile strength of the asphalt concrete. | $5.00/Ton for 1/4% fibers by weight. | Under field test in Region 10 to evaluate ability to reduce reflective cracks. Good performance after one year's service. |
| Sulfur Extended Asphalt | Asphalt cement substitute - up to 30%. | Depends on cost of liquid sulfur | Under field test in Region 8.<br><br>Good performance.<br><br>Not cost effective at this time. |
| Crumb Rubber | Increases pavements resistance to thermal cracking. | | Tests planned in future. |
| Stability Enhancers - Several products are available. Consult with the Materials Bureau. | Increases stability of the pavement and resists deformation to pavement at intersections, etc. | | No experience to date. |
| LONGITUDINAL GROOVING ON AC PAVEMENTS. | Sections of roadways where wet weather accidents occur due to hydroplaning. | Data not available | Not likely to improve pavement friction numbers if the pavement has poor microtecture.<br><br>Grooves in pavement surface will be obliterated by traffic in warm weather. Limited experience. |
| A temporary improvement to pavement traction when the pavement has insufficient macro texture. | | | |

## ASPHALT CONCRETE PAVEMENT (ACP) TREATMENTS

| TREATMENT | APPLICATION | COST | REMARKS |
|---|---|---|---|
| COLD MILLING OF AC PAVEMENTS<br>ITEM 18490.4031 | Allows partial pavement removal to:<br>1. Reestablish curb reveal.<br>2. Reestablish overhead clearances.<br>3. Eliminates raising manhole, etc.<br>4. Eliminates truing and leveling. | $1.25/sy | Equipment readily available. Reclaimed material may be suitable for recycling. Use of reclaimed material in recycled mixtures is a contractors option on selected courses. |
| REMOVING OLD BITUMINOUS CONCRETE OVERLAY<br>ITEM 202.20 | For complete removal of overlay. | $1.50/cy | Usually removed by front end loader. Material can be crushed for recycling. |
| UNCLASSIFIED EXCAVATION AND DISPOSAL<br>ITEM 203.02 | For complete removal of pavement. | $3.25/sy | Contractor may choose to reclaim material for recycling. |
| PAVEMENT INTERLAYERS - Fabric-placed either over the entire pavement surface or just the cracks. | Reduction of reflective cracks through the asphalt overlay. | $1.90/sy | No pavement interlayer system has prevented reflective cracks in asphalt concrete overlays on PCC pavements. The Engineering Research and Development Bureau is testing both fabric and rubberized liquid asphalt interlayers on badly thermal cracked asphalt pavement. No results are available as yet. |
| RUBBERIZED LIQUID ASPHALT CEMENT - applied as a surface treatment and covered by a layer of clean aggregate. | | | |

## ASPHALT CONCRETE PAVEMENT (ACP) TREATMENTS

| TREATMENT | APPLICATION | COST | REMARKS |
|---|---|---|---|
| ASPHALT EMULSION SURFACE TREATMENT<br>ITEM 15410.0103<br><br>A preventive maintenance treatment consisting of applying an emulsion to the pavement surface followed by the application of 1ST size aggregate. | Pavement surface for rural AC roads having an AADT not exceeding 2000 vehicles. | $0.50/sy | Good results depend very heavily on good design and construction procedures.<br><br>Not suitable for State highways in cities, villages or hamlets under any circumstances. |
| TACK COAT<br>ITEM 407.0101<br><br>A diluted emulsified asphalt cement for bonding new asphalt concrete layers to existing surfaces. | Any asphalt pavement with a milled surface, all PCC pavement surfaces, or on any asphalt concrete pavement surface receiving a total overlay thickness less than 2 inches<br>See EI 82-42. | $1.50/gal<br>or<br>$0.075/sy | The diluted emulsion is not a stable material. It requires agitation to maintain homogenity.<br><br>Application rates are critical.<br><br>No suitable substitute to the diluted emulsion has been found.<br><br>Good results when handled properly. See Construction Manual, P. 407-1. |

## ASPHALT CONCRETE PAVEMENT (ACP) TREATMENTS

| TREATMENT | APPLICATION | COST | REMARKS |
|---|---|---|---|
| CLEANING, SEALING AND FILLING JOINTS AND CRACKS<br>ITEM 633.05 | Cleaning, sealing and filling joints and cracks in the existing AC or PCC pavements. | $1.50/LF | Joints or cracks should not be filled to the top with liquid material to allow room for the expansion of the liquid when the hot overlay is placed.<br><br>Maintenance is using asphalt and rubberized asphalt for crack sealing operations. |
| CLEANING EXISTING PAVEMENT AND/OR SHOULDERS<br>ITEM 633.0202 | Cleaning the existing pavement prior to the application of a new course. Cleaning shoulders when they are overlaid. | $0.10/sy | |