



U.S. Department
of Transportation
**Federal Highway
Administration**

1200 New Jersey Ave., SE
Washington, D.C. 20590

March 30, 2011

In Reply Refer To:
HSST/LS-72

Mr. Zach Thiemann, E.I.T.
Associate Product Development Engineer
Valmont Industries, Inc.
7002 North 288th Street
P.O. Box 358
Valley, NE 68064-0358

Dear Mr. Thiemann:

This letter is in response to your request for the Federal Highway Administration (FHWA) acceptance of roadside safety systems for use on the National Highway System (NHS).

Name of system:	Valmont Decorative Clamshell Base Covers
Type of system:	Breakaway Luminaire Support Structure
Test Level:	NCHRP Report 350 Test Level 3
Testing conducted by:	Valmont-MwRSF/UNL Pendulum Facility
Date of request:	September 24, 2010
Date of completed package:	September 24, 2010
Request initially acknowledged:	September 30, 2010

You requested that we find these systems acceptable for use on the NHS under the provisions of the National Cooperative Highway Research Program (NCHRP) Report 350 "Recommended Procedures for the Safety Performance Evaluation of Highway Features."

Requirements

Roadside safety devices should meet the guidelines contained in the National Cooperative Highway Research Program (NCHRP) Report 350 or the American Association of State Highway and Transportation Officials' (AASHTO) Manual for Assessing Safety Hardware (MASH). Requirements for breakaway supports are those in the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals.

Decision

The following devices were found acceptable:

- Valmont decorative bases over TRANSPO Couplings on certain poles as detailed in this letter.



Description

Clamshell base covers are installed on luminaire poles for aesthetic purposes. The Valmont Industries system described in this submission includes (1) a breakaway system; (2) a decorative clamshell base; (3) a pole; and (4) a luminaire arm.

For the breakaway system, four 1 inch (25 mm) diameter TRANSPO Industries double neck, pole safe, couplings were used to fasten the pole to the foundation as shown in Enclosure 1. These couplers were previously accepted in FHWA acceptance letter LS-45B dated on January 16, 1997.

Valmont Industries evaluated five different styles of decorative clamshell bases in this request namely, (1) Huntington; (2) Washington; (3) Harrisburg; (4) Memphis; and (5) Osceola. Each may be fabricated in multiple sizes to accommodate various luminaire poles. The decorative clamshell bases are cast in two halves from either a 319F or 356F aluminum alloy. The two halves are bolted together using four 3/8 inch (10 mm) diameter bolts, two near the top and two near the bottom. The clamshell does not attach directly to the pole but only wraps around the base of the pole and rests on the ground. Design details for each of the models are shown in Enclosure 4 through 24.

Valmont Industries fabricates various poles and luminaire arms. In order to test the system, one of the Valmont Industries taller, thicker, and heavier poles was selected. The round steel pole was fabricated with a 7-gauge (4.55 mm) wall thickness and had a height of 38 feet, 6 inches (11.7 m). The nominal height to the luminaire was 45 feet (13.7 m). The pole had a top outside diameter of 4-1/2 inches (114 mm) and a bottom outside diameter of 10-3/8 inches (263 mm). A handhole was located on the pole centered at a height of 1 foot, 6 inches (0.5 m) from the base of the pole. Two mounting points for luminaire arms were located 6 inches (152 mm) and 33 inches (838 mm) from the top of the pole. The pole is shown in Enclosure 2. The pole base plate, 1 inch (25 mm) thick by 14 inches (356 mm) square, was welded to the bottom of the pole. The bolt circle was 13-1/2 inches (343 mm) in diameter.

The luminaire arm attached to the pole had a length of 15 feet (4.6 m) as shown in Enclosure 3. The arm was braced with two struts at locations of 5 feet and 10 feet (1.5 m and 3m) laterally from the pole.

Crash Testing

Pendulum testing was conducted on the test articles described above by Valmont-MwRSF/UNL Pendulum Facility. The testing was conducted according to NCHRP 350 test designation 3-60. The following table shows test IDs, clamshell styles tested, and weights of pieces of each test article.

Test ID	Clamshell Style	Clamshell Size (inch)*	Clamshell Weight (lb)	Pole Weight (lb)	Luminaire Arm Weight (lb)
LST-353-04	Huntington	24	47	548	175
LST-353-05	Washington	30	113	548	175
LST-381-01	Memphis	18	57	571	165
LST-381-02	Harrisburg	22	56	571	165
LST-381-03	Osceola	24	89	571	165

* Base Diameter

Summaries of test results for tests LST-353-04 and LST-353-05 are shown in Enclosures 25 and 26 respectively. Enclosures 27 through 29 summarize test results for tests LST-381-01 through LST-381-03 respectively.

Findings

According to the NCHRP 350, test designation 3-60 and test designation 3-61 are to be conducted for support structures for Test Level 3 approval. In both tests full scale automobile testing with an 820C small car is required. As described before, five pendulum tests were conducted as a surrogate for a low speed test with an 820C vehicle. In these tests occupant impact velocity, occupant ridedown acceleration, and maximum vehicle speed change (where measured) were found to be within the acceptable limits of NCHRP 350. The couplings and luminaire poles broke away in a consistent and predictable manner. The base of the pole rotated away from impact to allow a vehicle to travel underneath it. Therefore, the test article passed the low speed test.

The breakaway system used includes TRANSPO Industries double neck bolts. In tests LST-381-01 through LST-381-03, two bolts broke at the upper neck. In test LST-353-04, one bolt broke at the upper neck and in test LST-353-05 all bolts broke at the lower necks. For those bolts that broke at the upper neck, remaining stubs were 6 inches above the ground whereas those broke at the lower neck had stubs remaining that were 3 inches above the ground. The AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals require that any “substantial remains” of the breakaway support not project greater than 4 inches above ground level to avoid vehicle undercarriage snagging. It was judged that the stubs in these crash tests that measured more than 4 inches would not present a significant hazard. This was due to the fact that the breakaway elements of the stubs, the lower neck, was present and thus the remaining stubs are themselves breakaway systems which would give way on subsequent impact, reducing potential snagging.

FHWA allows the results of the high speed tests to be estimated using data from the low-speed test in combination with an analytical extrapolation method described in the FHWA memorandum “Identifying Acceptable Highway Safety Features” dated on July 25, 1997. For all five test articles, the high speed test extrapolation analysis resulted in change in velocity values for the high speed tests above the NCHRP 350 limit of 5.0 m/s and all five test articles failed the test.

The equation for extrapolation to obtain results for the high speed test includes mechanical properties of the test article, the speed at which low speed and high speed tests are conducted, and the speed change of the test vehicle during the low speed test. It is intuitive that in both low speed and high speed tests, a heavier pole with greater moment of inertia/radius of gyration and longer luminaire would cause more speed change for the impacting vehicle. As described in this letter, Valmont Industries selected critical poles and luminaire arm combinations (i.e., tall, heavy, thick poles with long luminaire arms) for the low speed tests. Experience has shown that any less critical (lighter) poles will cause smaller speed change for the impacting vehicles.

In your request, you have estimated the results of the high speed tests for various combinations of poles, luminaire arms, and clamshell bases that Valmont Industry fabricates using the analytical equation. In these estimations you used the speed changes obtained from the low speed tests which are more conservative speed changes for these less critical combinations.

Therefore, if the result of the extrapolation for each combination satisfies the requirements of NCHRP Report 350, I agree that the combination passes test 3-61.

The following tables illustrate all combinations which passed test 3-60 and 3-61. These poles can be used with single or twin arms shorter or equal to 15 ft or top mount luminaires weigh less than 150 pounds where applicable. In these tables, the cells containing “X” represent the pole and aesthetic clamshell base covers that are compatible with each other and determined to pass both tests. It should be noted that a pole that falls between any two poles shown in these two tables is also acceptable and can be used on the NHS provided that all other conditions of this letter are satisfied.

It should be noted that the pole, luminaire arm, and clamshell base covers must meet the conditions and limitations of TRANSPO Industries breakaway couplings identified in FHWA acceptance letter LS-45B particularly the followings:

- All supports shall be mounted to a structural concrete foundation that will not move in the soil if the support is struck by a vehicle.
- Luminaire mounting height should not exceed 15.7 meters (55 feet).
- Mass of pole, mast arm, luminaire and other hardware above the couplings shall not exceed 454 kg (1000 lbs.).

Therefore, the system described in the requests above and detailed in the enclosed drawings is acceptable for use on the NHS under the range of conditions tested, when such use is acceptable to a highway agency.

Family - Type	Pole				Aesthetic Clamshell Base Covers										
	Shaft Length (ft)	Mounting Height (ft)	Thickness (ga.)	Base O.D. (in.)	Huntington			Washington			Memphis		Harris- burg	Osceola	
					24	17	12	30	24	18	18	15	22	24	17
DS30	20	21	11	5.90		X				X		X			X
DS30	25	26	11	5.90		X				X		X			X
DS30	30	31	11	6.60	X				X			X	X		X
DS30	35	36	11	7.30	X				X		X	X	X		X
DS30	35	36	11	8.50	X				X		X	X	X		
DS30	39	40	11	9.00	X				X		X		X		
DS50	17	20	11	5.90		X				X		X			X
DS50	17	20	11	6.50	X				X			X	X		X
DS50	22	25	11	5.90		X				X		X			X
DS50	22	25	11	7.00	X				X			X	X		X
DS50	27	30	11	6.60	X				X			X	X		X
DS50	27	30	11	7.50	X				X		X	X	X		X
DS50	30	32	11	6.60	X				X			X	X		X
DS50	30	32	11	8.00	X				X		X	X	X	X	
DS50	32	35	11	7.30	X				X		X	X	X		X
DS50	32	35	11	8.00	X				X		X	X	X	X	
DS50	37	40	11	9.00	X				X		X		X		
DS50	42	45	11	9.50	X						X		X		
DS60	20	25	11	6.50	X				X			X	X		X
DS60	20	25	11	7.00	X				X			X	X		X
DS60	25	30	11	7.00	X				X			X	X		X
DS60	25	30	11	7.50	X				X		X	X	X		X
DS60	25	30	11	8.00	X				X		X	X	X	X	
DS60	30	35	11	8.00	X				X		X	X	X	X	
DS60	30	35	11	8.50	X				X		X	X	X		
DS60	35	40	11	9.00	X				X		X		X		

DS70	22	25	11	7.00	X				X			X	X		X
DS70	27	30	11	7.50	X				X		X	X	X		X
DS70	27	30	11	8.00	X				X		X	X	X	X	
DS70	32	35	11	8.00	X				X		X	X	X		
DS70	32	35	11	8.50	X				X		X	X	X		
DS70	32	35	11	9.00	X				X		X		X		
DS70	37	40	11	9.00	X				X		X		X		
DS70	37	40	11	9.50	X						X		X		
DS32	28.5	30	11	7.50	X				X		X	X	X		X
DS32	28.5	30	11	8.00	X				X		X	X	X	X	
DS32	33.5	35	11	8.00	X				X		X	X	X	X	
DS32	33.5	35	11	8.50	X				X		X	X	X		
DS32	33.5	35	11	9.00	X				X		X		X		
DS32	38.5	40	11	9.00	X				X		X		X		
DS32	38.5	40	11	9.50	X						X		X		
DS32	38.5	40	11	10.00	X						X		X		
DS32	43.5	45	11	9.50	X						X		X		
DS32	43.5	45	11	10.00	X						X		X		

X = Passes Requirements for all Luminaire Arm Possibilities
 = Aesthetic Clamshell Base Not Compatible With Pole

Family - Type	Pole				Aesthetic Clamshell Base Covers											
	Shaft Length (ft)	Mounting Height (ft)	Thickness (ga.)	Base O.D. (in.)	Huntington			Washington			Memphis		Harris-burg	Osceola		
					24	17	12	30	24	18	18	15	22	24	17	
DS210	20	20	11	5.90		X				X		X				X
DS210	20	20	11	6.50	X				X			X	X			X
DS210	25	25	11	5.90		X				X		X				X
DS210	25	25	11	7.00	X				X			X	X			X
DS210	25	25	7	7.00	X				X			X	X			X
DS210	30	30	11	6.60	X				X			X	X			X
DS210	30	30	11	8.00	X				X		X	X	X	X		
DS210	35	35	11	7.30	X				X		X	X	X			X
DS210	35	35	11	8.50	X				X		X	X	X			
DS210	35	35	11	9.50	X						X		X			
DS210	39	39	11	7.82	X				X		X	X	X			X
DS210	39	39	11	9.00	X				X		X		X			
DS210	45	45	11	10.00	X						X		X			
DS210	50	50	11	10.00	X						X		X			
FL210	20	20	11	6.72	X				X			X	X			X
FL210	25	25	11	7.30	X				X		X	X	X			X
FL210	25	25	7	7.75	X				X		X	X	X			X
FL210	30	30	11	8.00	X				X		X	X	X	X		
FL210	30	30	7	8.00	X				X		X	X	X			
FL210	35	35	11	8.45	X				X		X	X	X			
FL210	35	35	7	9.00	X						X		X			
FL210	39	39	11	9.00	X				X		X		X			
FL210	39	39	7	10.00												
Custom	20	23	7	6.00		X				X		X				X
Custom	20	23	7	7.00	X				X			X	X			X
Custom	25	28	7	6.00		X				X		X				X
Custom	25	28	7	7.00	X				X			X	X			X
Custom	25	28	7	7.75	X				X		X	X	X			X
Custom	25	28	7	8.00	X				X		X	X	X			X
Custom	30	33	7	7.00	X				X			X	X			X
Custom	30	33	7	7.75	X				X		X	X	X			X
Custom	30	33	7	8.00	X				X		X	X	X			

X = Passes Requirements for all DS70 Luminaire Arm or Top Mount Possibilities
 = Aesthetic Clamshell Base Not Compatible With Pole

Please note the following standard provisions that apply to FHWA letters of acceptance:

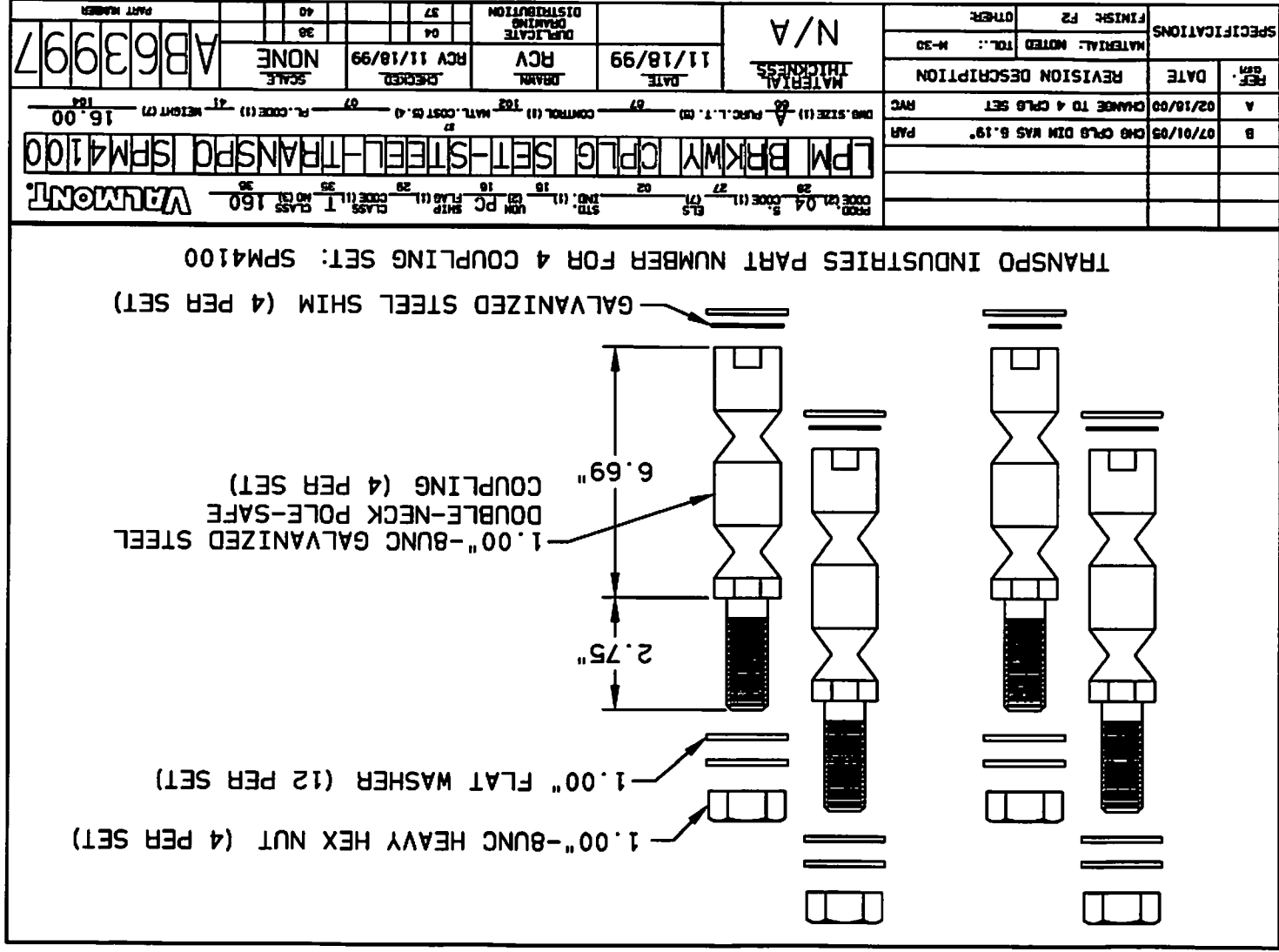
- This acceptance is limited to the crashworthiness characteristics of the systems and does not cover their structural features, nor conformity with the Manual on Uniform Traffic Control Devices.
- Any changes that may adversely influence the crashworthiness of the system will require a new acceptance letter.
- Should the FHWA discover that the qualification testing was flawed, that in-service performance reveals unacceptable safety problems, or that the system being marketed is significantly different from the version that was crash tested, we reserve the right to modify or revoke our acceptance.
- You will be expected to supply potential users with sufficient information on design and installation requirements to ensure proper performance.
- You will be expected to certify to potential users that the hardware furnished has essentially the same chemistry, mechanical properties, and geometry as that submitted for acceptance, and that it will meet the crashworthiness requirements of the FHWA and the NCHRP Report 350.
- To prevent misunderstanding by others, this letter of acceptance is designated as number LS-72 and shall not be reproduced except in full. This letter and the test documentation upon which it is based are public information. All such letters and documentation may be reviewed at our office upon request.
- The Decorative Clamshell Bases are patented products and considered proprietary. If proprietary systems are specified by a highway agency for use on Federal-aid projects, except exempt, non-NHS projects, (a) they must be supplied through competitive bidding with equally suitable unpatented items; (b) the highway agency must certify that they are essential for synchronization with the existing highway facilities or that no equally suitable alternative exists; or (c) they must be used for research or for a distinctive type of construction on relatively short sections of road for experimental purposes. Our regulations concerning proprietary products are contained in Title 23, Code of Federal Regulations, Section 635.411.
- This acceptance letter shall not be construed as authorization or consent by the FHWA to use, manufacture, or sell any patented system for which the applicant is not the patent holder. The acceptance letter is limited to the crashworthiness characteristics of the candidate system, and the FHWA is neither prepared nor required to become involved in issues concerning patent law. Patent issues, if any, are to be resolved by the applicant.

Sincerely yours,



Michael S. Griffith
Director, Office of Safety Technologies
Office of Safety

Figure 14. Breakaway Coupler Details



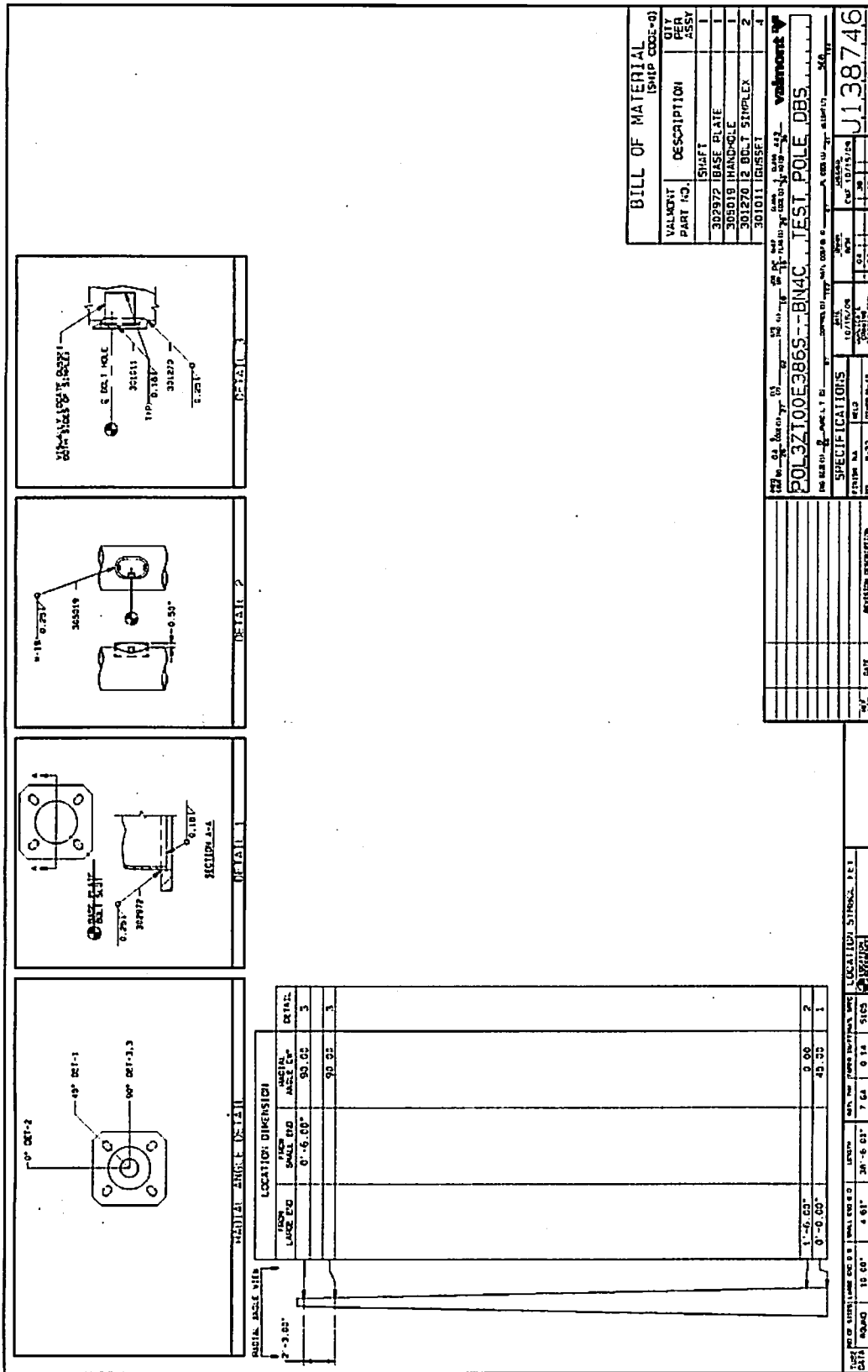


Figure 12. Steel Pole Details
ENCLOSURE #2

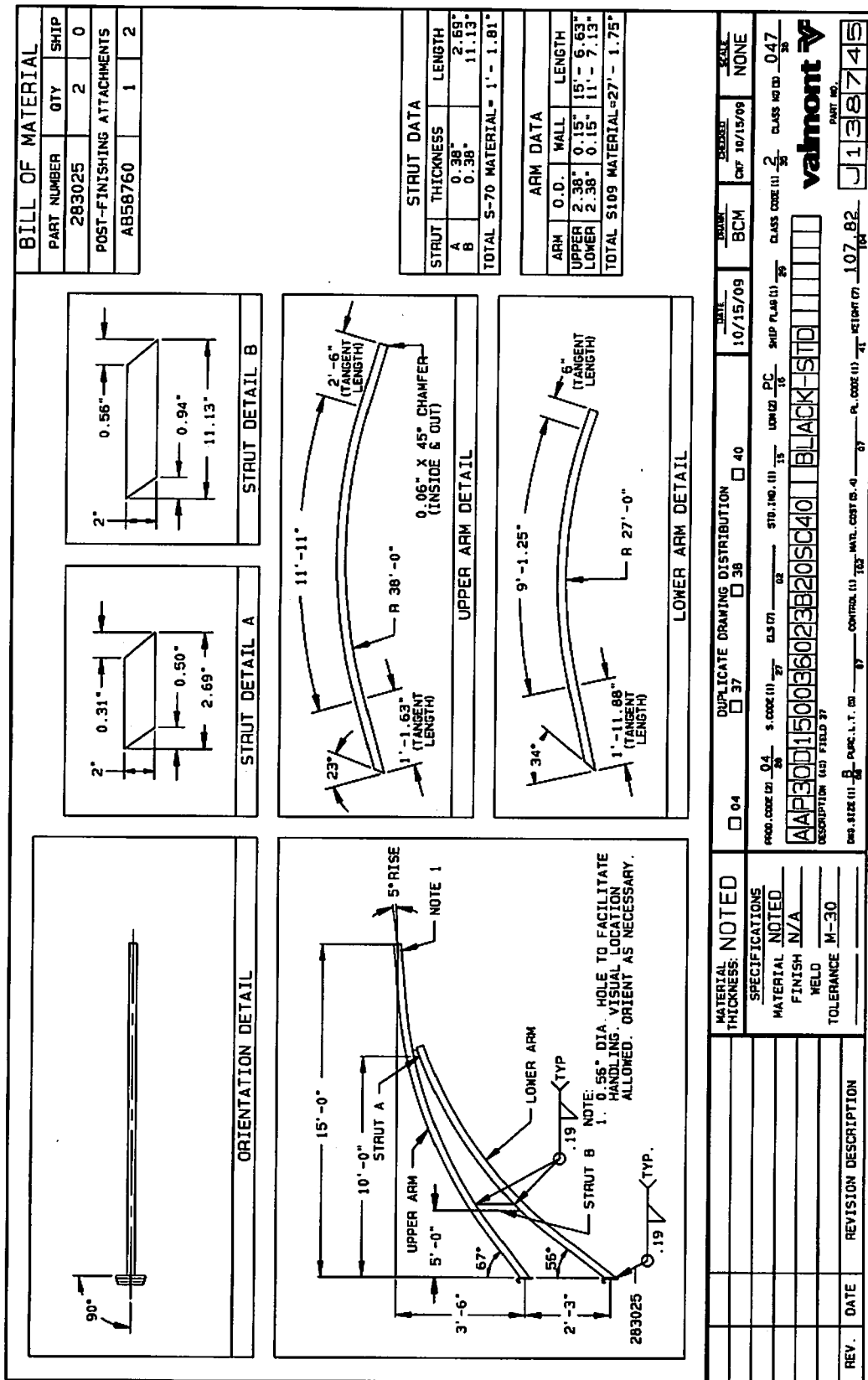


Figure 13. Luminaire Arm Details
ENCLOSURE #3

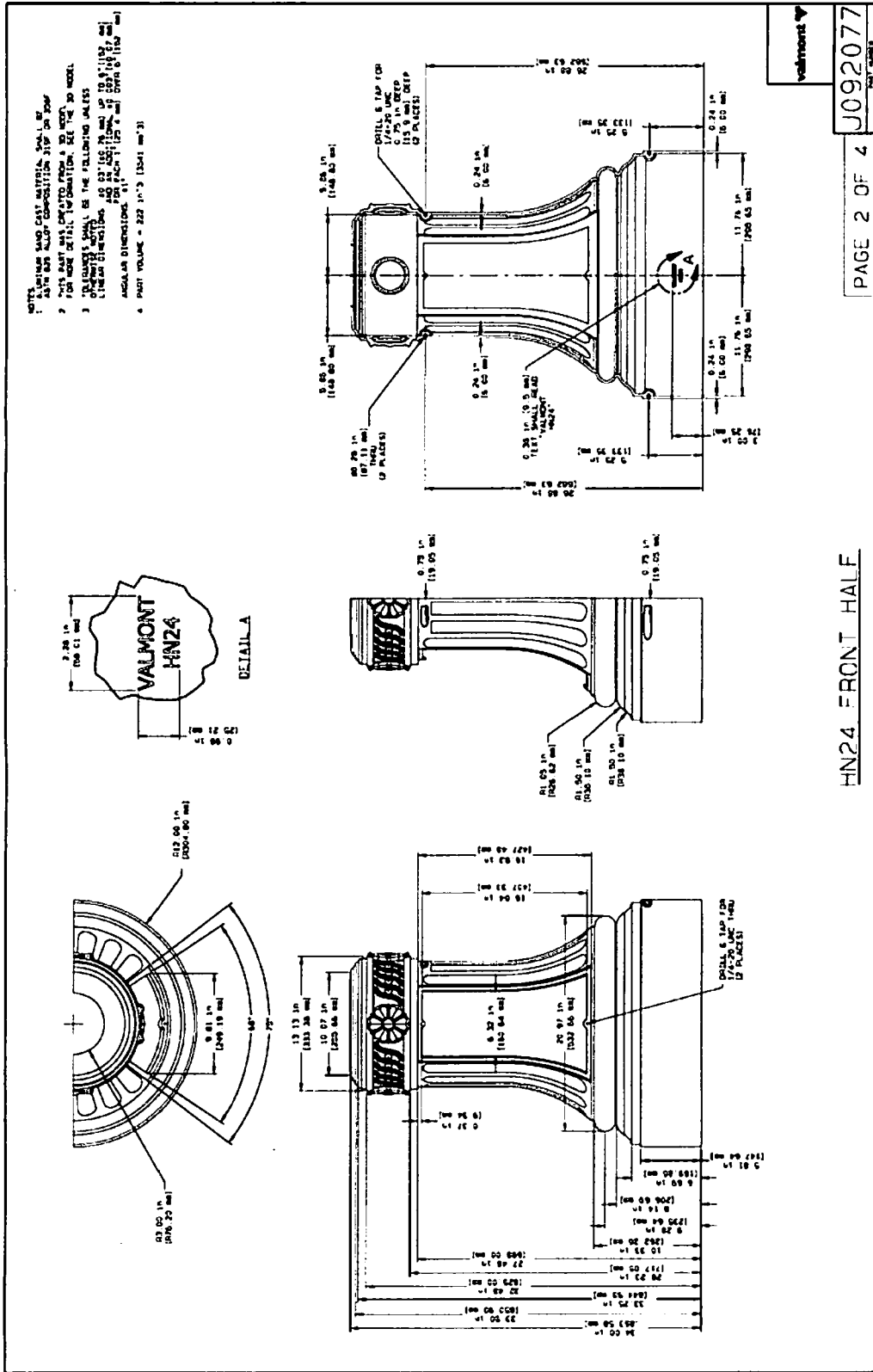


Figure 16. Huntington-24 Clamshell Base Details, Test No. LST-353-04
ENCLOSURE # 5

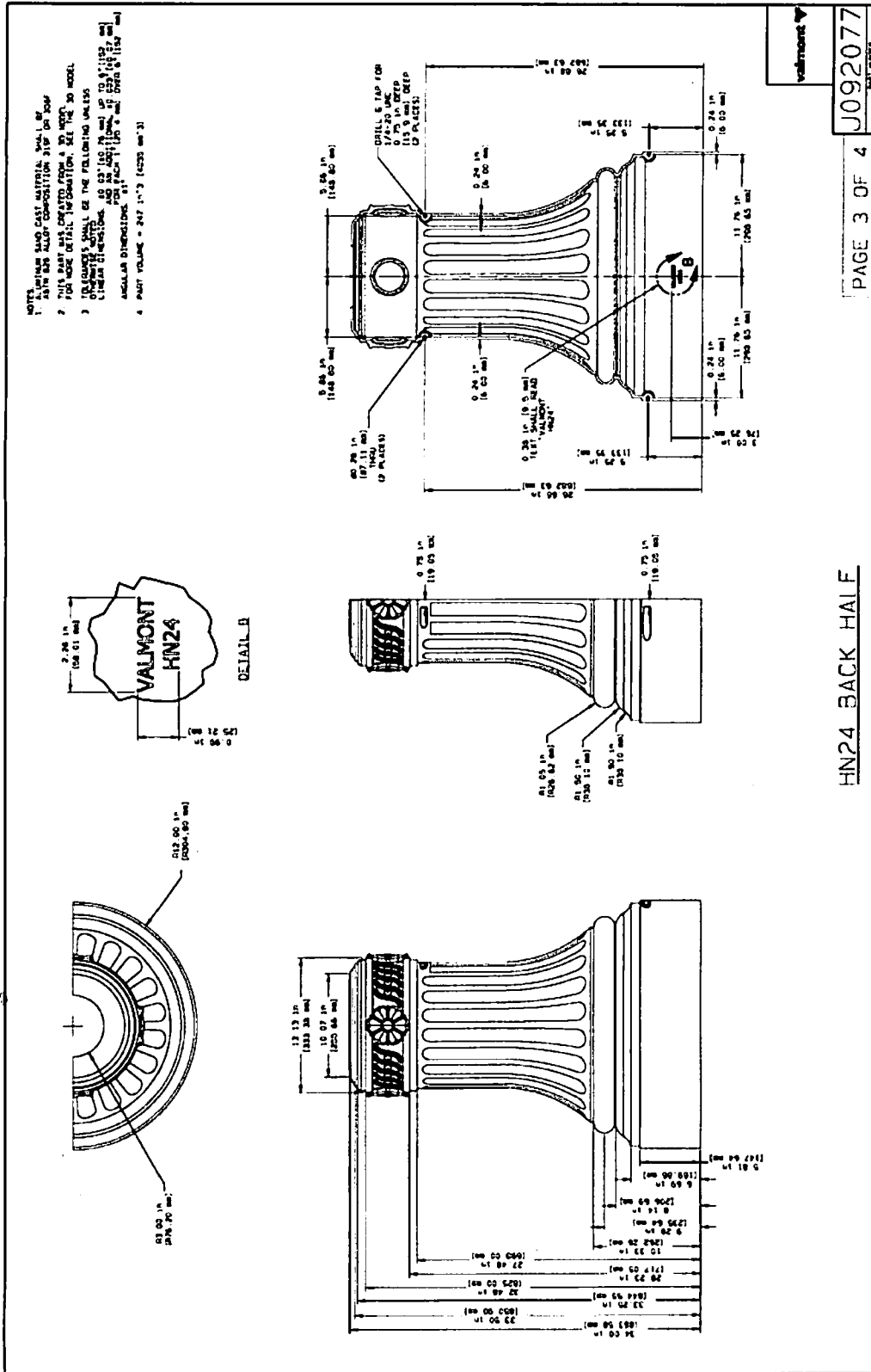
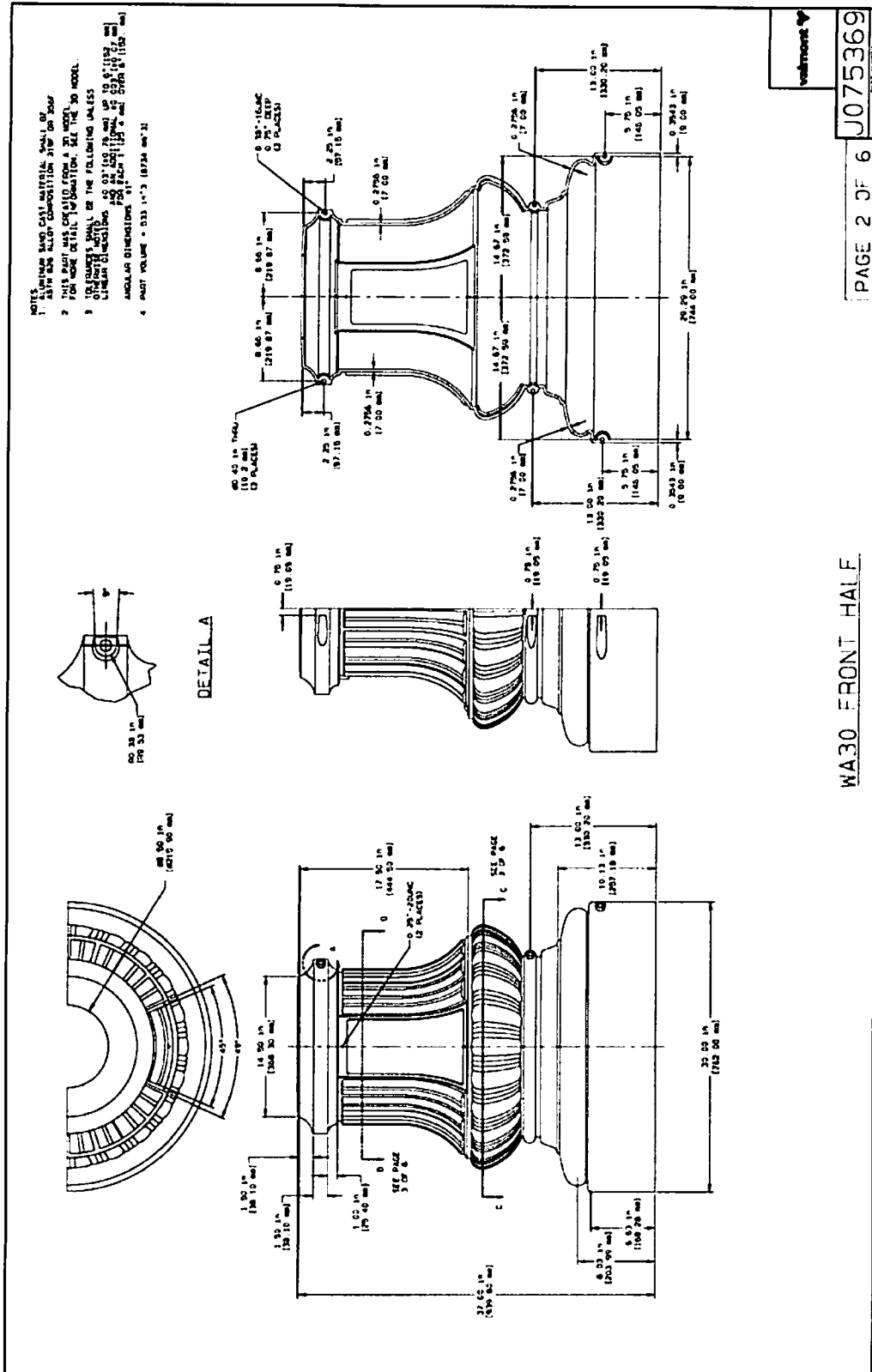


Figure 17. Huntington-24 Clamshell Base Details, Test No. LST-353-04

ENCLOSURE #6



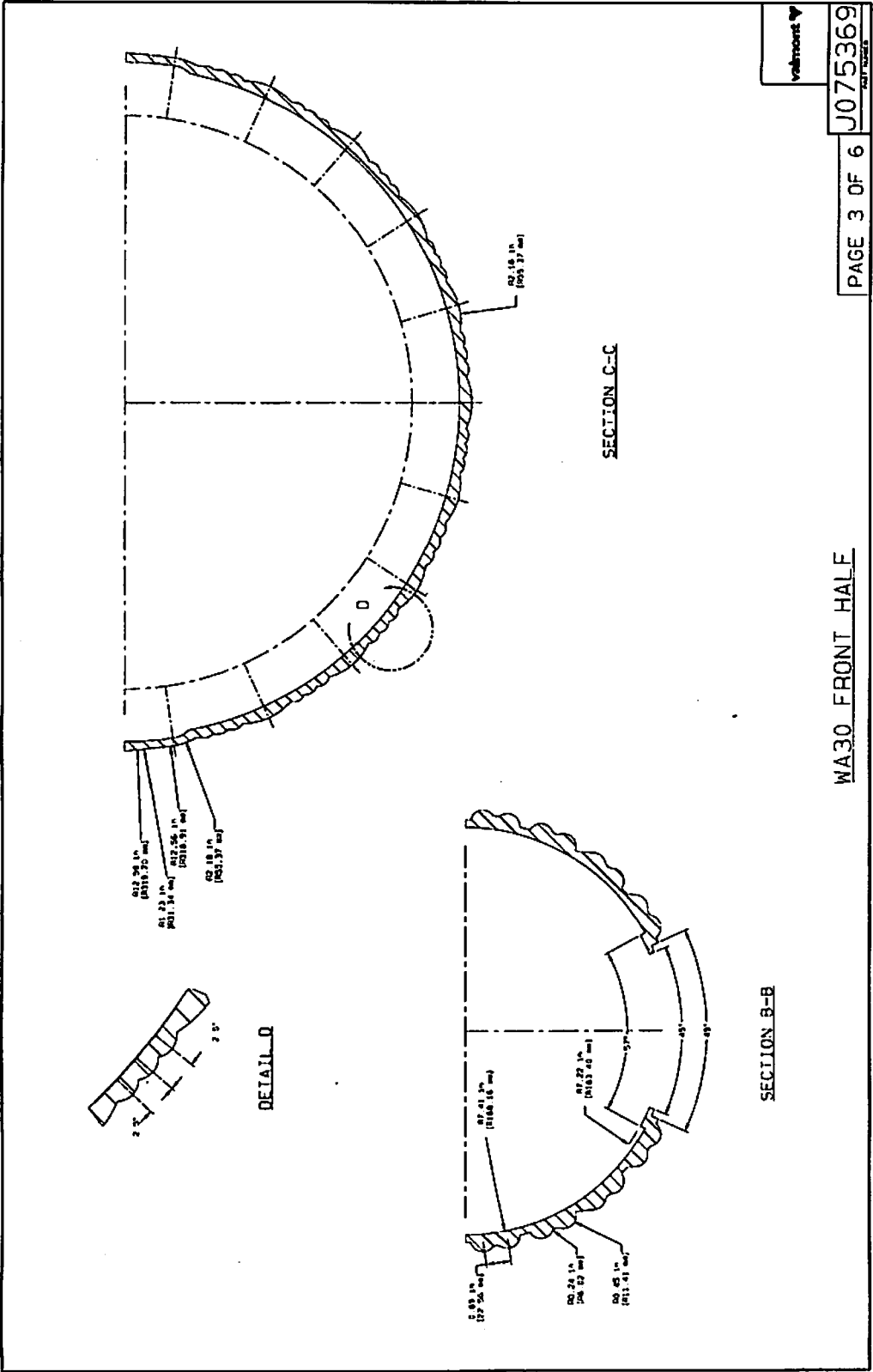


Figure 21. Washington-30 Clamshell Base Details, Test No. LST-353-05
 ENCLOSURE #10

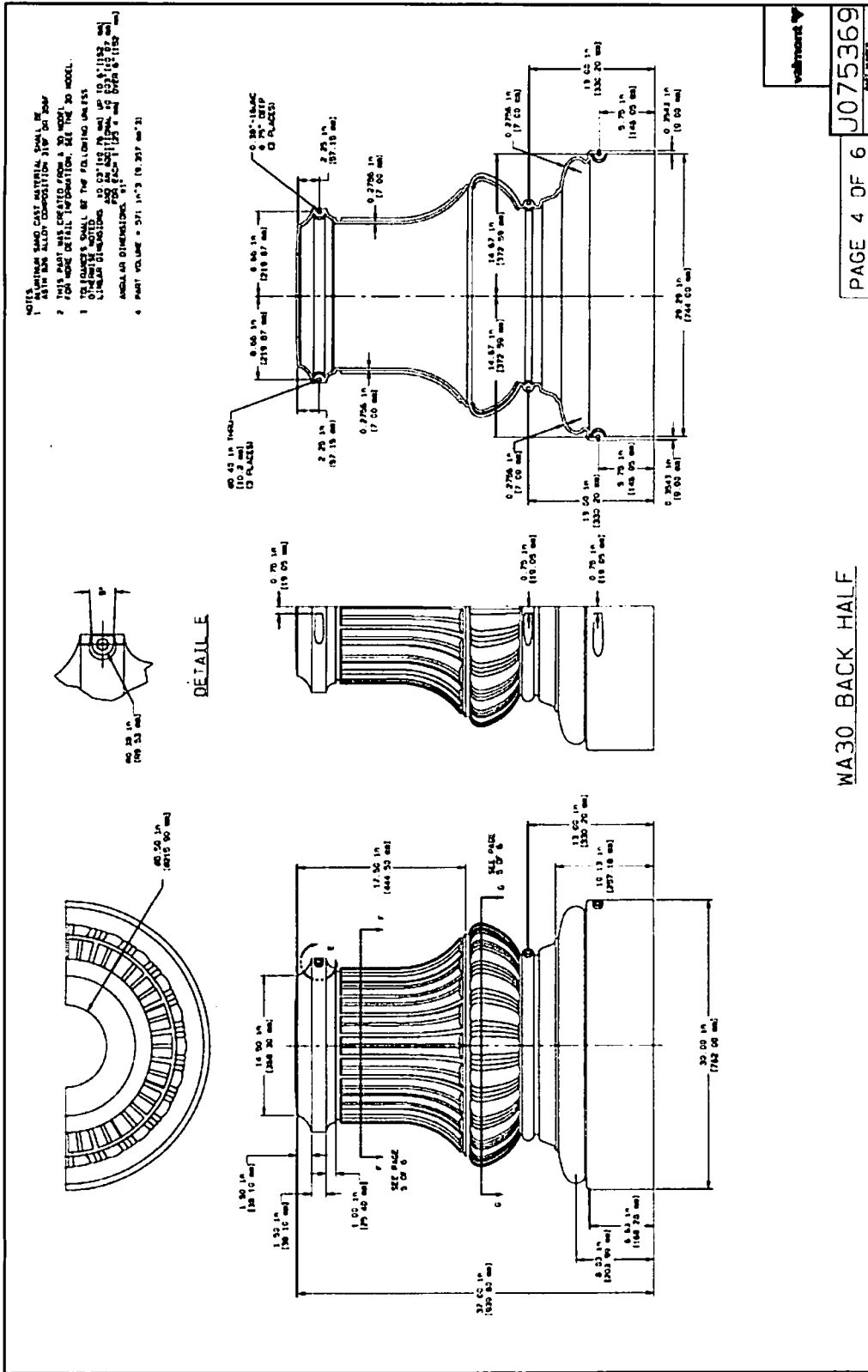


Figure 22. Washington-30 Clamshell Base Details, Test No. LST-353-05

ENCLOSURE #11

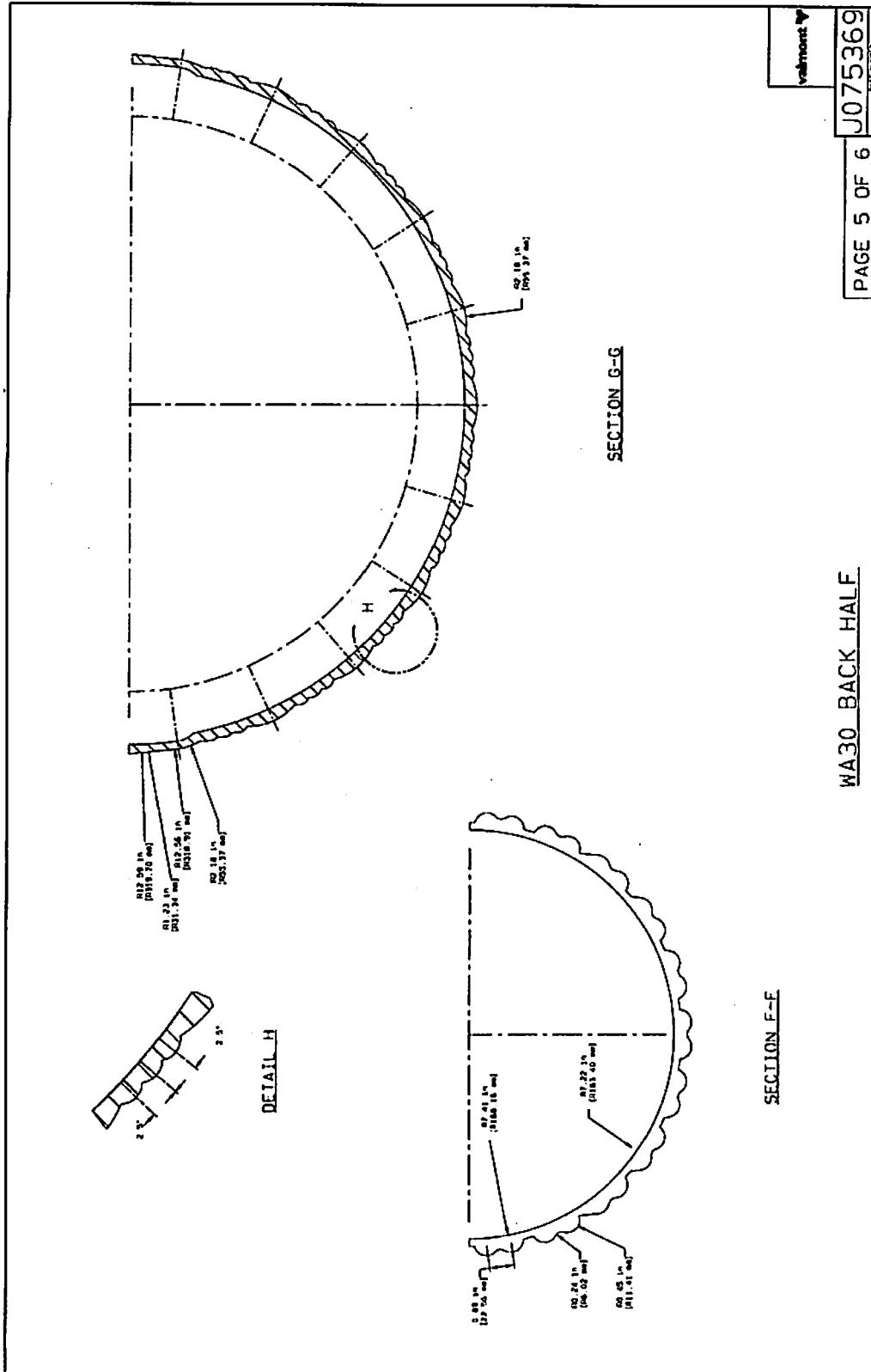


Figure 23. Washington-30 Clamshell Base Details, Test No. LST-353-05
ENCLOSURE #12

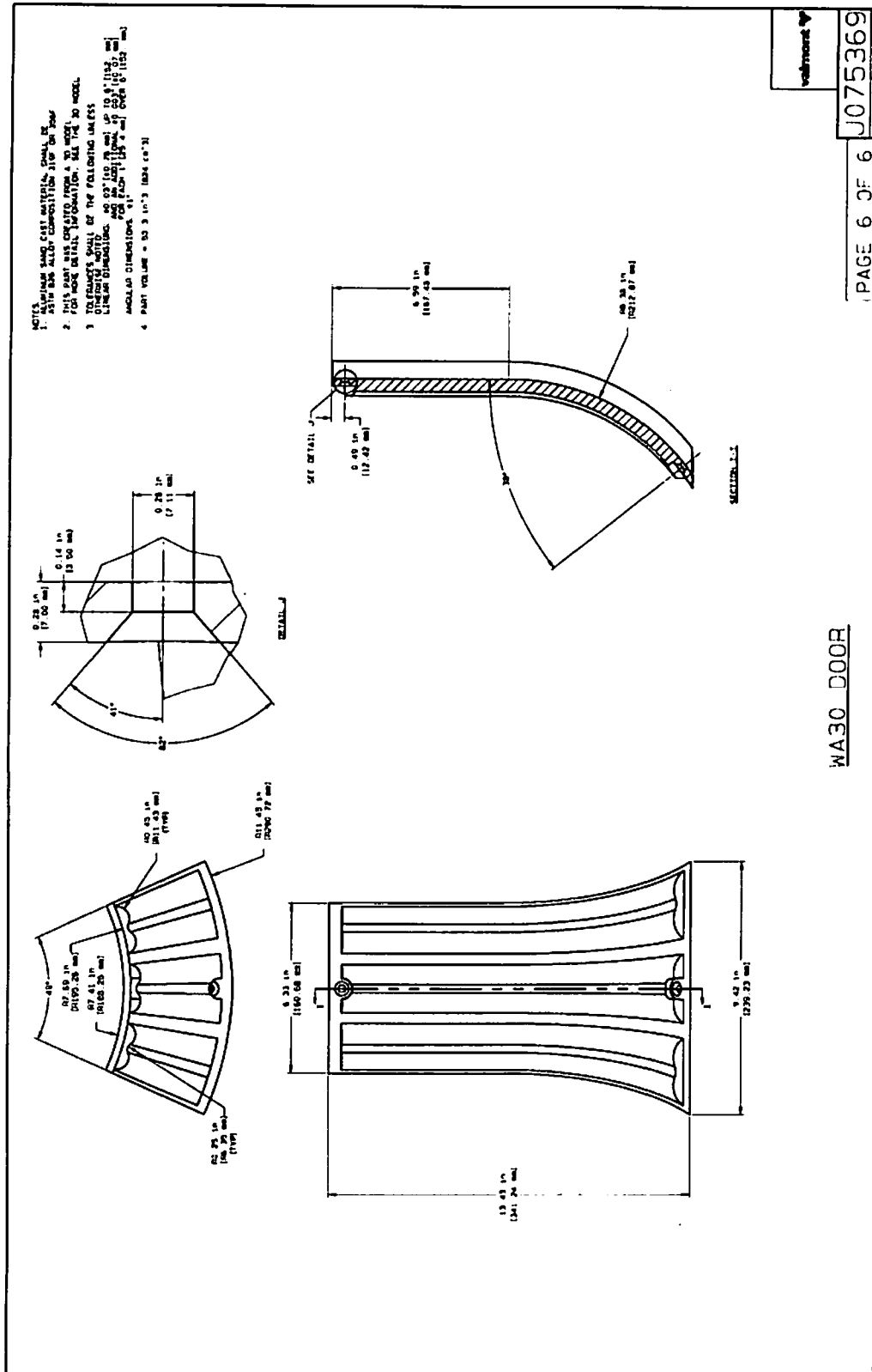


Figure 24. Washington-30 Clamshell Base Details, Test No. LST-353-05

ENCLOSURE #13

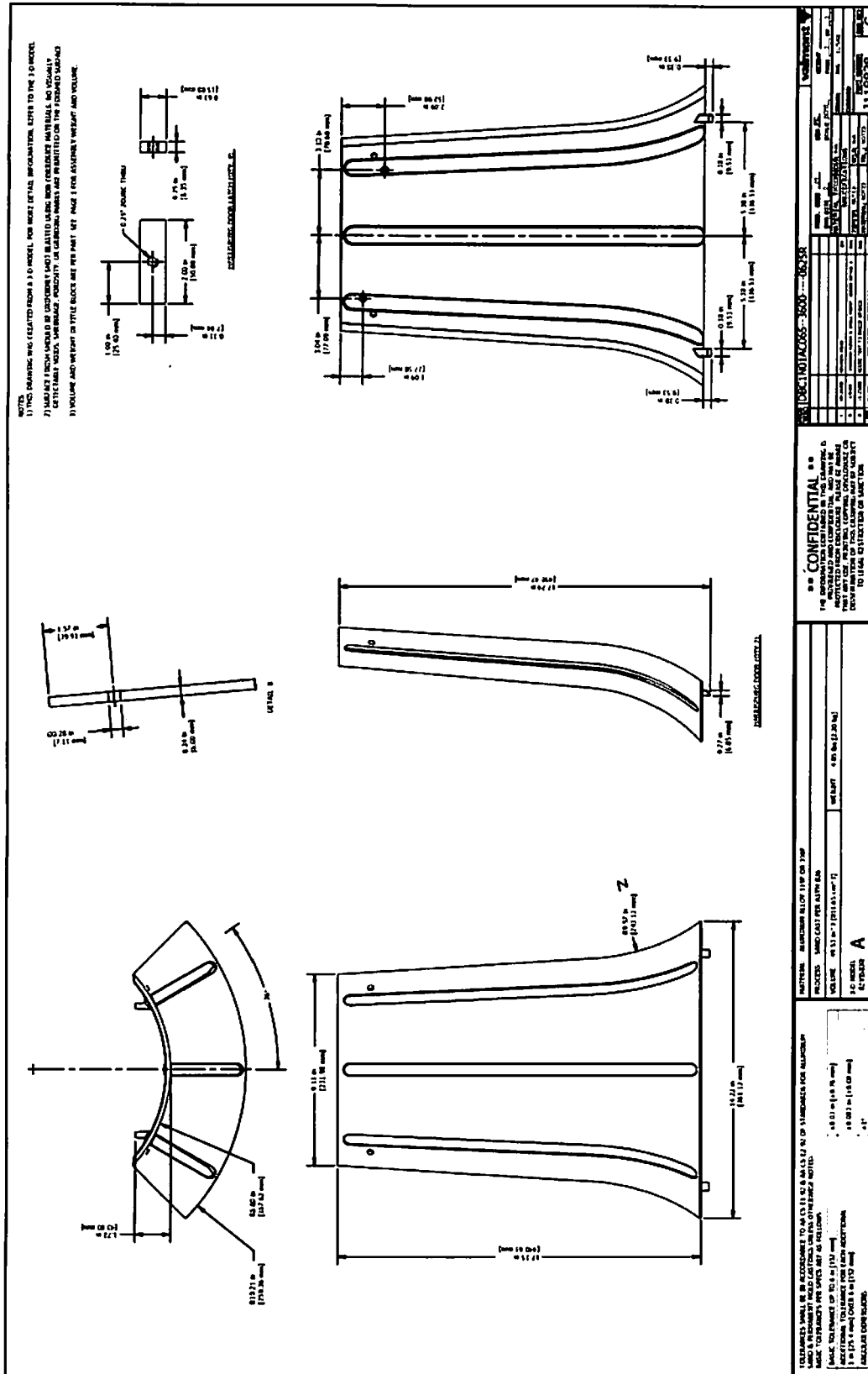


Figure 27. Harrisburg-22 Clamshell Base Details, Test No. LST-381-01
ENCLOSURE #16

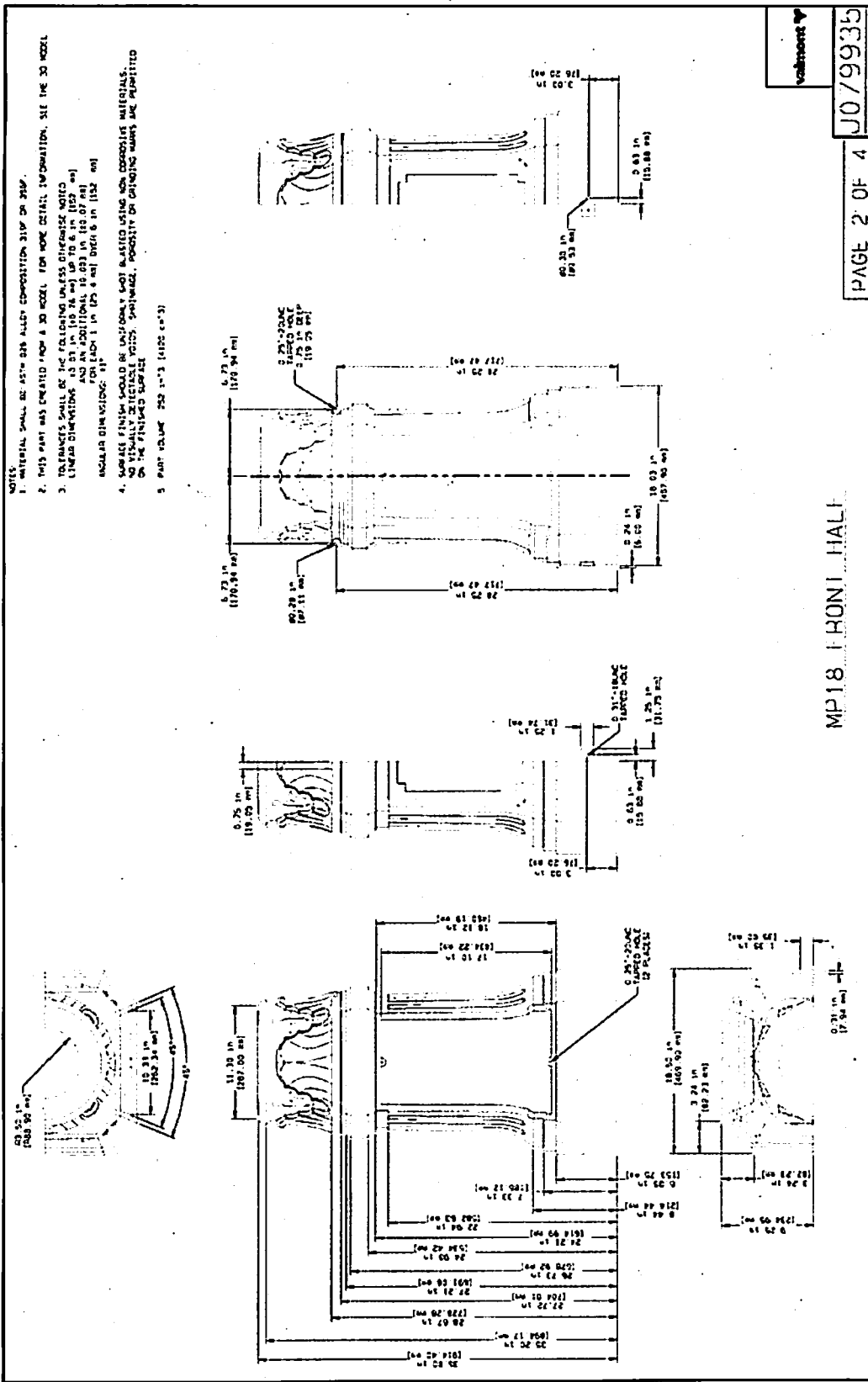
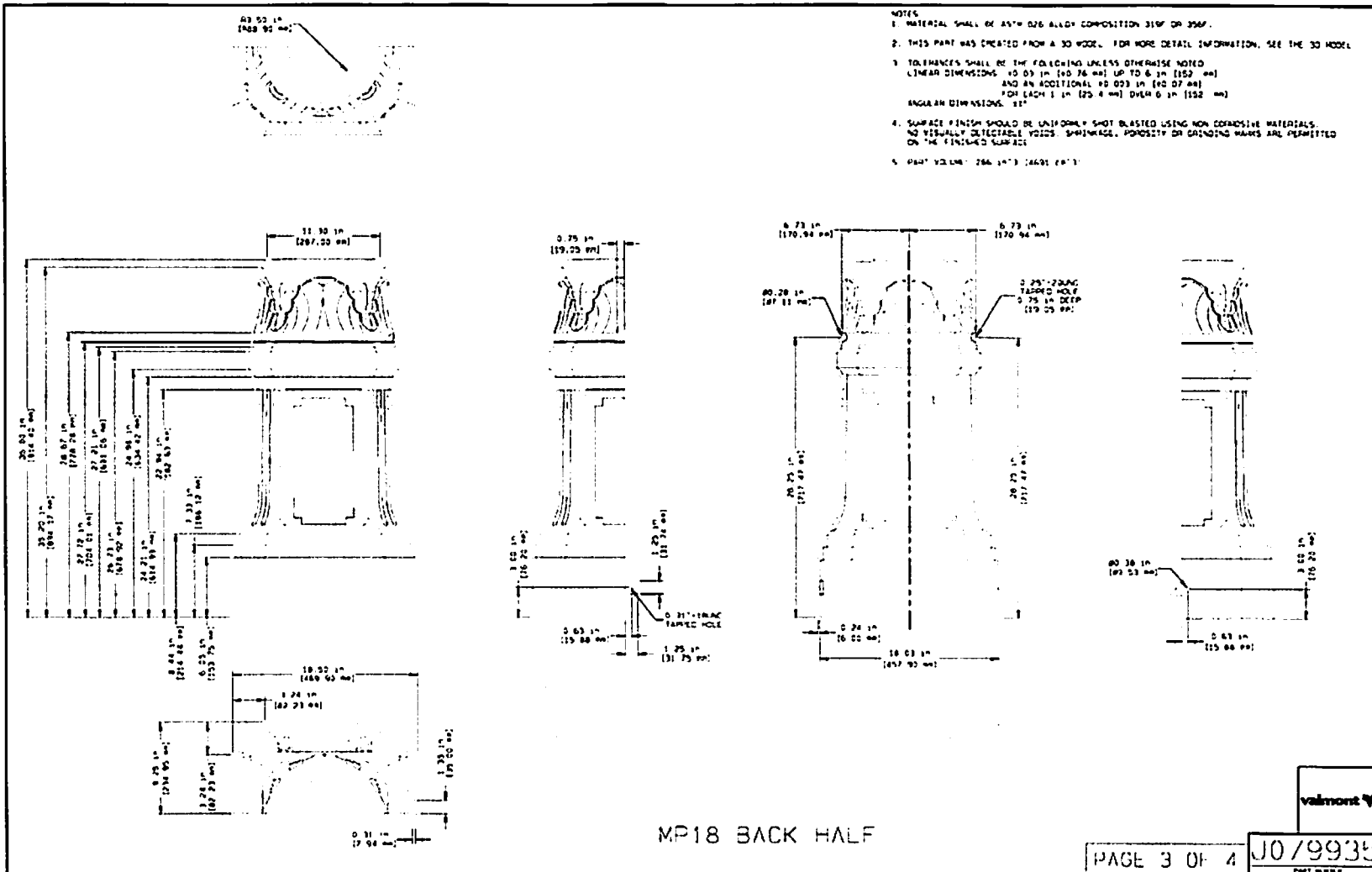


Figure 29. Memphis-18 Clamshell Base Details, Test No. LST-381-02
ENCLOSURE #18

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- NOTES
1. MATERIAL SHALL BE A578 026 ALLOY COMPOSITION 316F OR 306F.
 2. THIS PART WAS CREATED FROM A 3D MODEL. FOR MORE DETAIL INFORMATION, SEE THE 3D MODEL.
 3. TOLERANCES SHALL BE THE FOLLOWING UNLESS OTHERWISE NOTED:
 LINEAR DIMENSIONS: ± 0.03 IN (± 0.76 MM) UP TO 6 IN (152 MM)
 AND AN ADDITIONAL ± 0.03 IN (± 0.76 MM)
 FOR EACH 1 IN (25.4 MM) DIAM 6 IN (152 MM)
 ANGULAR DIMENSIONS: $\pm 1^\circ$
 4. SURFACE FINISH SHOULD BE UNIFORM, SHOT-BLASTED USING NON-CORROSIVE MATERIALS. NO VISUALLY DETECTABLE VOIDS, SPINWHEEL, POROSITY OR GRINDING MARKS ARE PERMITTED ON THE FINISHED SURFACE.
 5. PART VOLUME: 286 IN³ (4691 CM³)

Figure 30. Memphis-18 Clamshell Base Details, Test No. LST-381-02

ENCLOSURE #19

MWRSF Report No. TRP-03-229-10 August 11, 2010

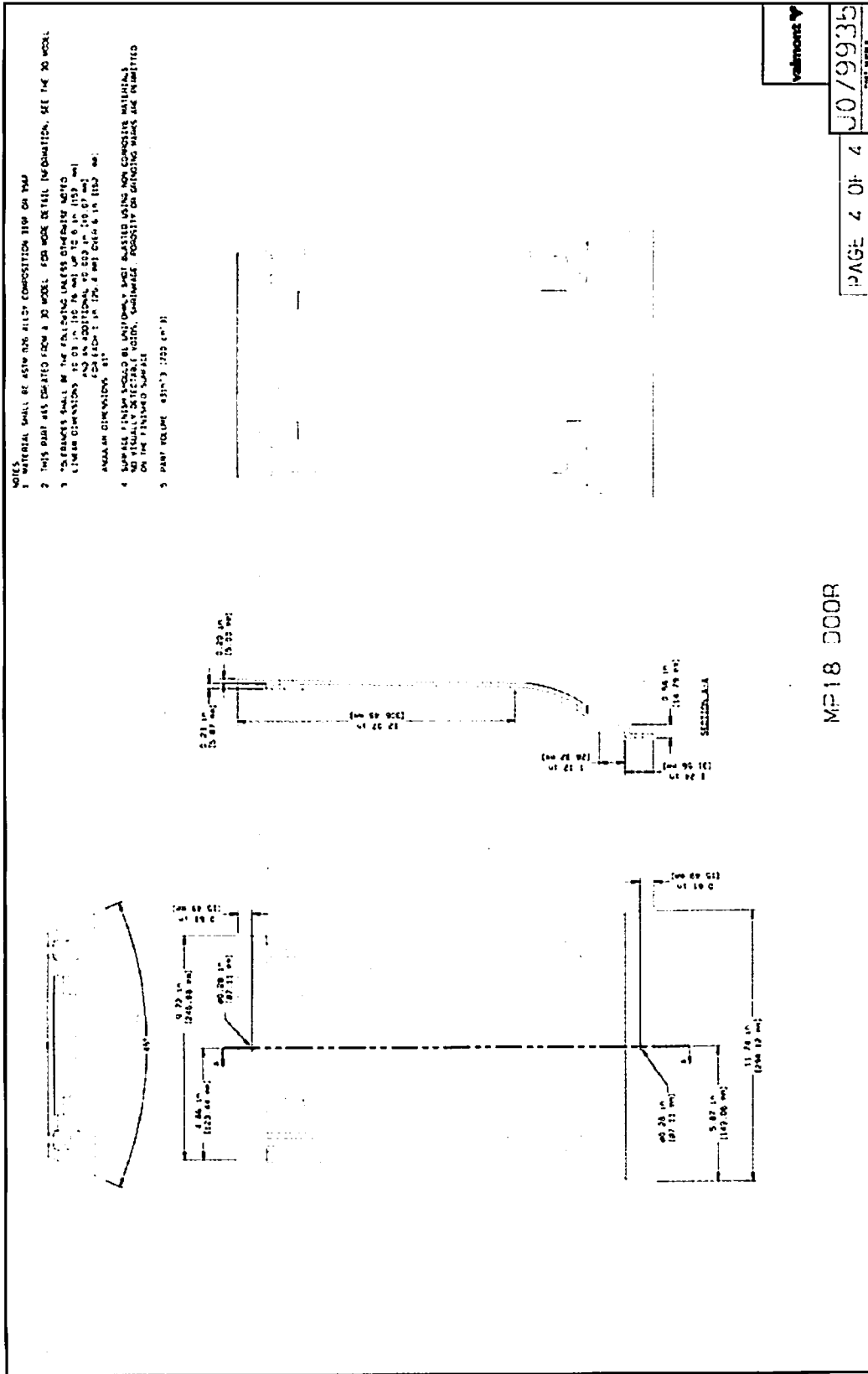


Figure 31. Memphis-18 Clamshell Base Details, Test No. LST-381-02

ENCLOSURE #20

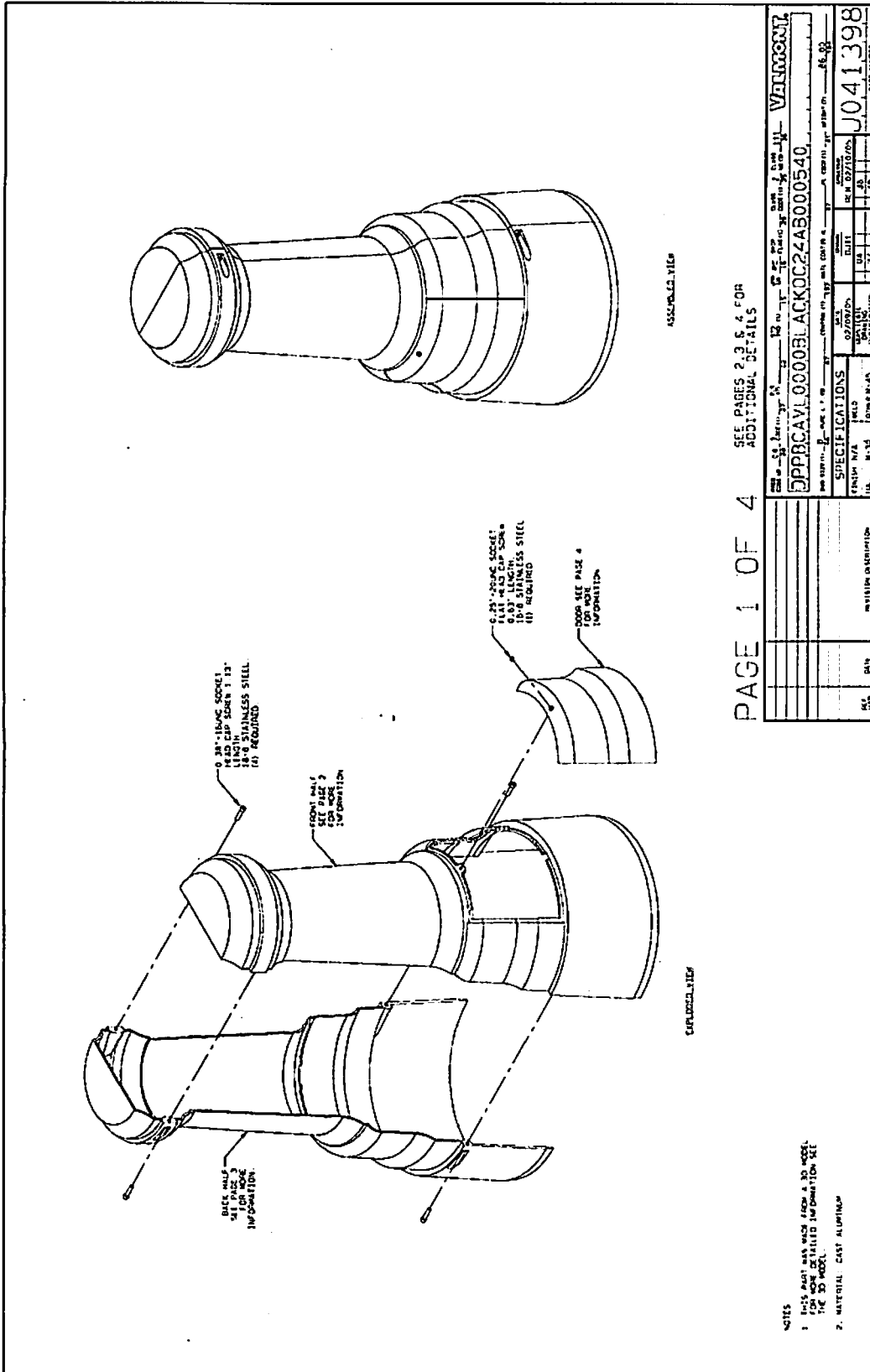


Figure 32. Oscola-24 Clamshell Base Details, Test No. LST-381-03

ENCLOSURE #21

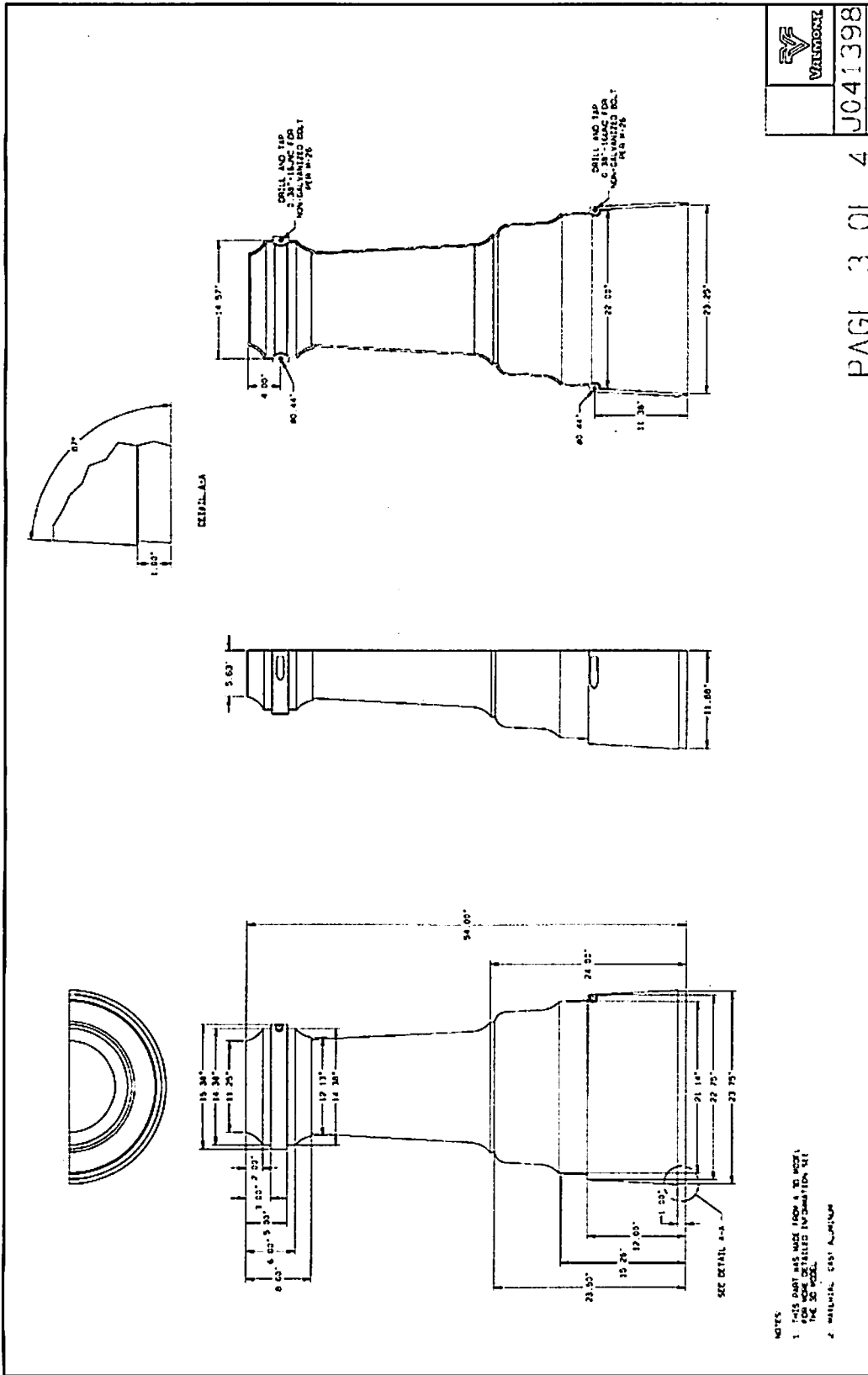


Figure 34. Osccola-24 Clamshell Base Details, Test No. LST-381-03
ENCLOSURE #23

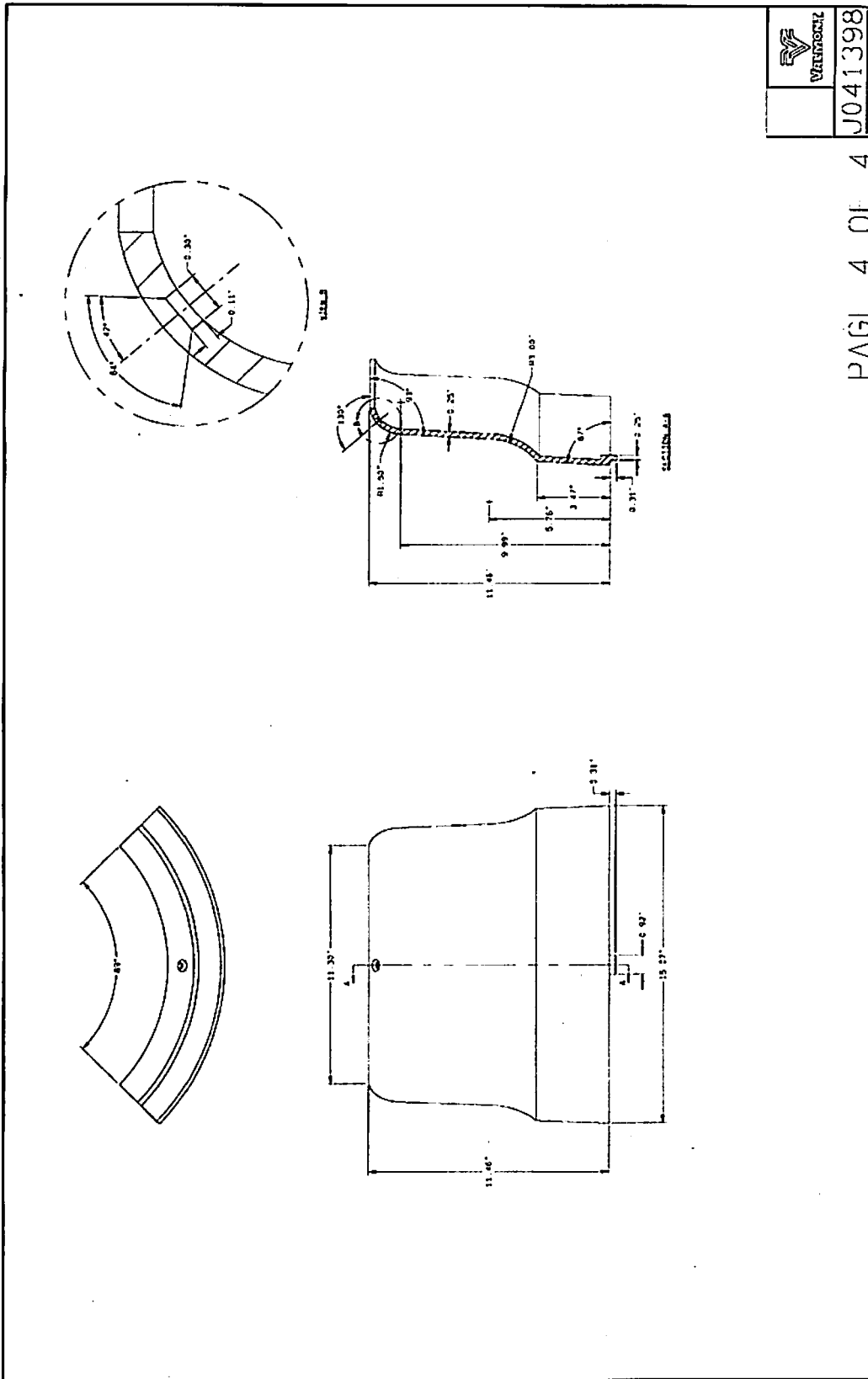
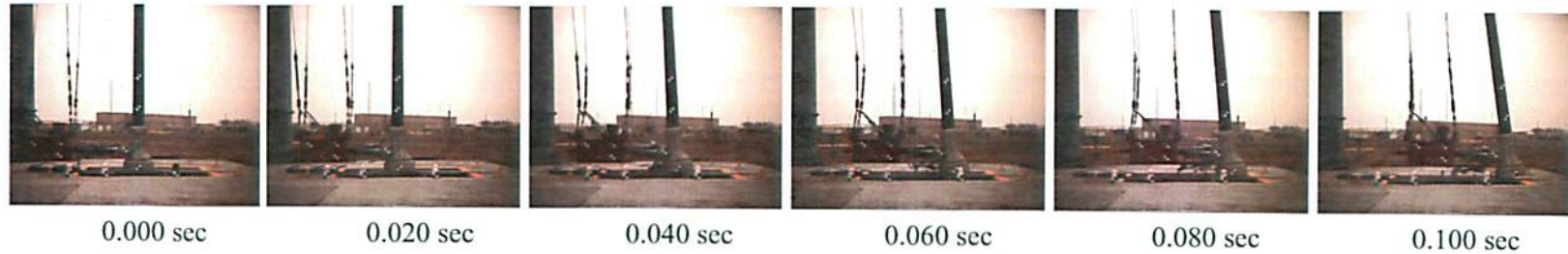


Figure 35. Oscola-24 Clamshell Base Details, Test No. LST-381-03

ENCLOSURE #24



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- Test Agency..... MwRSF
- Test Facility..... Valmont-MwRSF/UNL Pendulum
- Test Number..... LST-353-04
- Date 11/23/09
- NCHRP Report No. 350 Test Designation Number.....3-60
- Test Article..... Huntington-24 Clamshell Base on Steel Pole
- Nominal Height..... 45 ft (13.7 m)
- Key Component – Tapered Steel Pole
 - Height 38 ft - 6 in. (11.7 m)
 - Bottom Diameter 10.371 in. (263 mm)
 - Thickness..... 7-gauge (4.7-mm)
- Key Component – Luminaire Arm
 - Length..... 15 ft (4.6 m)
 - Mounting Height 38 ft (11.6 m)
- Key Component – Couplings
 - Type..... Transpo Industries Double-Neck Pole-Safe
 - Diameter 1 in. (25 mm)
- Key Component – Decorative Clamshell Base Cover
 - Model..... Huntington-24
 - Height 34 in. (834 mm)
 - Diameter 24 in. (610 mm)
- Total Installation Mass..... 770 lb (349 kg)
 - Pole 548 lb (249 kg)
 - Luminaire Arm Assembly..... 175 lb (79 kg)
 - Clamshell Base 47 lb (21 kg)
- Surrogate Vehicle..... Pendulum
 - Mass..... 1,858 lb (843 kg)
 - Impact Head..... Crushable Nose

- Impact Conditions
 - Speed 21.8 mph (35.1 km/h)
 - Angle 0 deg
 - Impact Height..... 17½ in. (445 mm)
- Test Article Damage
 - Pole..... Minimal
 - Base..... Moderate
- Stub Height
 - Three Occurrences 3 in. (76 mm)
 - One Occurrence 6 in. (152 mm)
- Transducer Data

Evaluation Criteria	Transducer			NCHRP Report 350 Limit
	EDR-3	DTS		
		BR39H	CM54H	
Longitudinal OIV ft/s (m/s)	NA (no occupant contact)	NA	NA	≤16.4 (5.0)
Longitudinal ORA g's	NA (no occupant contact)	NA	NA	≤20
Maximum Vehicle ΔV ft/s (m/s)	9.97 (3.04)	NA	NA	≤16.4 (5.0)
ASI	0.49	NA	NA	not required

Figure 41. Summary of Test Results and Sequential Photographs, Test No. LST-353-04

ENCLOSURE #25



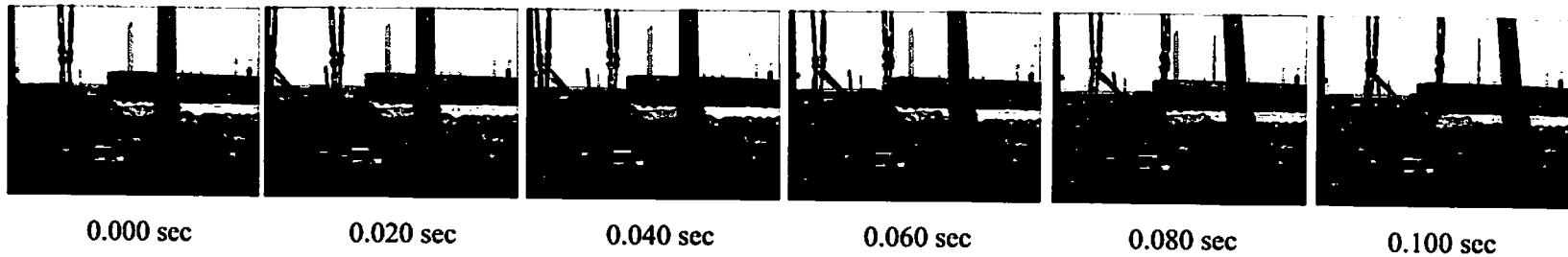
0.000 sec 0.020 sec 0.040 sec 0.060 sec 0.080 sec 0.100 sec

- Test Agency..... MwRSF
- Test Facility..... Valmont-MwRSF/UNL Pendulum
- Test Number..... LST-353-05
- Date 11/23/09
- NCHRP Report No. 350 Test Designation No 3-60
- Test Article..... Washington-30 Clamshell Base on Steel Pole
- Nominal Height..... 45 ft (13.7 m)
- Key Component – Tapered Steel Pole
 - Height 38 ft - 6 in. (11.7 m)
 - Bottom Diameter 10.371 in. (263 mm)
 - Thickness 7-gauge (4.7-mm)
- Key Component – Luminaire Arm
 - Length..... 15 ft (4.6 m)
 - Mounting Height 38 ft (11.6 m)
- Key Component – Couplings
 - Type..... TRANSP Industries Double-Neck Pole-Safe
 - Diameter 1 in. (25 mm)
- Key Component – Decorative Clamshell Base Cover
 - Model..... Washington-30
 - Height 37 in. (940 mm)
 - Diameter 30 in. (762 mm)
- Total Installation Mass..... 836 lb (379 kg)
 - Pole 548 lb (249 kg)
 - Luminaire Arm Assembly..... 175 lb (79 kg)
 - Clamshell Base 113 lb (51 kg)
- Surrogate Vehicle..... Pendulum
 - Mass..... 1,858 lb (843 kg)
 - Impact Head..... Crushable Nose

- Impact Conditions
 - Speed 21.8 mph (35.1 km/h)
 - Angle 0 deg
 - Impact Height..... 17½ in. (445 mm)
- Test Article Damage
 - Pole Minimal
 - Base Moderate
- Stub Height
 - Four Occurrences 3 in. (76 mm)
- Transducer Data

Evaluation Criteria	Transducer			NCHRP Report 350 Limit
	EDR-3	DTS		
		BR39H	CM54H	
Longitudinal OIV ft/s (m/s)	8.78 (2.68)	9.45 (2.88)	9.38 (2.86)	≤16.4 (5.0)
Longitudinal ORA g's	0.20	0.33	0.32	≤20
ASI	0.41	0.40	0.39	Not Required

Figure 45. Summary of Test Results and Sequential Photographs, Test No. LST-353-05



- Test Agency..... MwRSF
- Test Facility..... Valmont-MwRSF/UNL Pendulum
- Test Number..... LST-381-01
- Date 12/17/09
- NCHRP Report No. 350 Test Designation No 3-60
- Test Article..... Harrisburg-22 Clamshell Base on Steel Pole
- Nominal Height 45 ft (13.7 m)
- Key Component – Tapered Steel Pole
 - Height 38 ft - 6 in. (11.7 m)
 - Bottom Diameter 10.371 in. (263 mm)
 - Thickness 7-gauge (4.7-mm)
- Key Component – Luminaire Arm
 - Length 15 ft (4.6 m)
 - Mounting Height 38 ft (11.6 m)
- Key Component – Couplings
 - Type Transpo Industries Double-Neck Pole-Safe
 - Diameter 1 in. (25 mm)
- Key Component – Decorative Clamshell Base Cover
 - Model Harrisburg-22
 - Height 36 in. (914 mm)
 - Diameter 22 in. (559 mm)
- Total Installation Mass 793 lb (360 kg)
 - Pole 571 lb (259 kg)
 - Luminaire Arm Assembly 165 lb (75 kg)
 - Clamshell Base 57 lb (26 kg)
- Surrogate Vehicle Pendulum
 - Mass 1,862 lb (845 kg)
 - Impact Head Crushable Nose

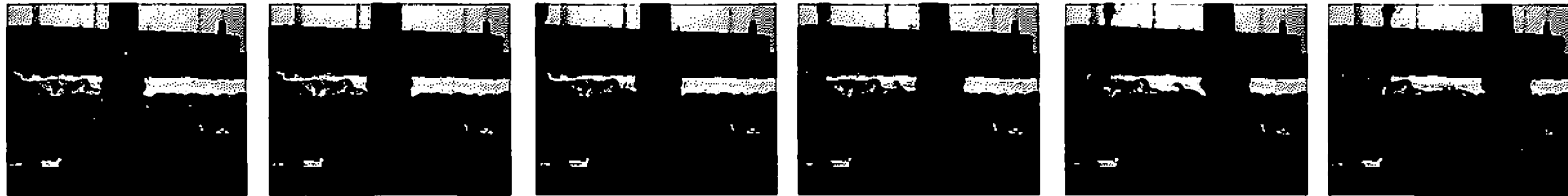
- Impact Conditions
 - Speed 21.8 mph (35.1 km/h)
 - Angle 0 deg
 - Impact Height 17½ in. (445 mm)
- Test Article Damage
 - Pole Minimal
 - Base Moderate
- Stub Height
 - Two Occurrences 6 in. (152 mm)
 - Two Occurrences 3 in. (76 mm)
- Transducer Data

Evaluation Criteria	Transducer			NCHRP Report 350 Limit
	EDR-3	DTS		
		BR39H	CMS4H	
Longitudinal OIV ft/s (m/s)	NA (no occupant contact)	NA (no occupant contact)	NA (no occupant contact)	≤16.4 (5.0)
Longitudinal ORA g's	NA (no occupant contact)	NA (no occupant contact)	NA (no occupant contact)	≤20
Maximum Vehicle ΔV ft/s (m/s)	8.33 (2.54)	8.07 (2.46)	8.33 (2.54)	≤16.4 (5.0)
ASI	0.40	0.41	0.42	Not Required

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Figure 49. Summary of Test Results and Sequential Photographs, Test No. LST-381-01

ENCLOSURE #27



0.000 sec 0.020 sec 0.040 sec 0.060 sec 0.080 sec 0.100 sec

- Test Agency..... MwRSF
- Test Facility..... Valmont-MwRSF/UNL Pendulum
- Test Number..... LST-381-02
- Date 12/17/09
- NCHRP Report No. 350 Test Designation No 3-60
- Test Article..... Memphis-18 Clamshell Base on Steel Pole
- Nominal Height..... 45 ft (13.7 m)
- Key Component – Tapered Steel Pole
 - Height..... 38 ft - 6 in. (11.7 m)
 - Bottom Diameter..... 10.371 in. (263 mm)
 - Thickness..... 7-gauge (4.7-mm)
- Key Component – Luminaire Arm
 - Length..... 15 ft (4.6 m)
 - Mounting Height..... 38 ft (11.6 m)
- Key Component – Couplings
 - Type..... Transpo Industries Double-Neck Pole-Safe
 - Diameter..... 1 in. (25 mm)
- Key Component – Decorative Clamshell Base Cover
 - Model..... Memphis-18
 - Height..... 36 in. (914 mm)
 - Diameter..... 18½ in. (470 mm)
- Total Installation Mass..... 792 lb (359 kg)
 - Pole..... 571 lb (259 kg)
 - Luminaire Arm Assembly..... 165 lb (75 kg)
 - Clamshell Base..... 56 lb (25 kg)
- Surrogate Vehicle..... Pendulum
 - Mass..... 1,862 lb (845 kg)
 - Impact Head..... Crushable Nose

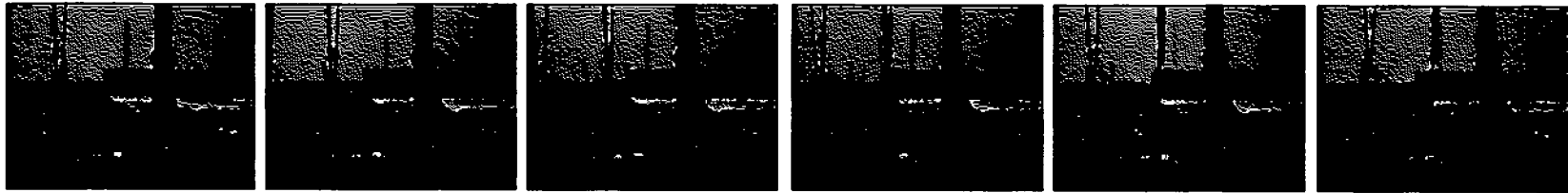
- Impact Conditions
 - Speed..... 21.8 mph (35.1 km/h)
 - Angle..... 0 deg
 - Impact Height..... 17½ in. (445 mm)
- Test Article Damage
 - Pole..... Minimal
 - Base..... Substantial
- Stub Height
 - Four Occurrences..... 3 in. (76 mm)
- Transducer Data

Evaluation Criteria	Transducer			NCHRP Report 350 Limit
	EDR-3	DTS		
		BR39H	CM54H	
Longitudinal OIV ft/s (m/s)	NA (no occupant contact)	NA (no occupant contact)	NA (no occupant contact)	≤16.4 (5.0)
Longitudinal ORA g's	NA (no occupant contact)	NA (no occupant contact)	NA (no occupant contact)	≤20
Maximum Vehicle ΔV ft/s (m/s)	8.20 (2.50)	8.04 (2.45)	8.10 (2.47)	≤16.4 (5.0)
ASI	0.39	0.41	0.42	Not Required

85

Figure 53. Summary of Test Results and Sequential Photographs, Test No. LST-381-02

ENCLOSURE #28



0.000 sec

0.020 sec

0.040 sec

0.060 sec

0.080 sec

0.100 sec

93

- Test Agency..... MwRSF
- Test Facility..... Valmont-MwRSF/UNL Pendulum
- Test Number..... LST-381-03
- Date 12/17/09
- NCHRP Report No. 350 Test Designation No 3-60
- Test Article..... Osceola-18 Clamshell Base on Steel Pole
- Nominal Height 45 ft (13.7 m)
- Key Component – Tapered Steel Pole
 - Height 38 ft - 6 in. (11.7 m)
 - Bottom Diameter 10.371 in. (263 mm)
 - Thickness 7-gauge (4.7-mm)
- Key Component – Luminaire Arm
 - Length 15 ft (4.6 m)
 - Mounting Height 38 ft (11.6 m)
- Key Component – Couplings
 - Type..... TRANSCO Industries Double-Neck Pole-Safe
 - Diameter 1 in. (25 mm)
- Key Component – Decorative Clamshell Base Cover
 - Model..... Osceola-18
 - Height 54 in. (1,372 mm)
 - Diameter 23½ in. (603 mm)
- Total Installation Mass 825 lb (374 kg)
 - Pole 571 lb (259 kg)
 - Luminaire Arm Assembly 165 lb (75 kg)
 - Clamshell Base 89 lb (40 kg)
- Surrogate Vehicle..... Pendulum
 - Mass 1,862 lb (845 kg)
 - Impact Head..... Crushable Nose

- Impact Conditions
 - Speed 21.5 mph (34.7 km/h)
 - Angle 0 deg
 - Impact Height 17½ in. (445 mm)
- Test Article Damage
 - Pole..... Minimal
 - Base Moderate
- Stub Height
 - One Occurrence..... 6 in. (152 mm)
 - Three Occurrences 3 in. (76 mm)
- Transducer Data

Evaluation Criteria	Transducer			NCHRP Report No. 350 Limit
	EDR-3	DTS		
		BR39H	CM54H	
Longitudinal OIV ft/s (m/s)	15.35 (4.68)	15.75 (4.80)	15.88 (4.84)	≤16.4 (5.0)
Longitudinal ORA g's	0.56	0.70	0.78	≤20
ASI	0.68	0.73	0.72	Not Required

Figure 57. Summary of Test Results and Sequential Photographs, Test No. LST-381-03

ENCLOSURE #29