INTERNATIONAL CAVITATION EROSION TEST
Test Rig Identification Card

Facility: vibratory rig (stationary specimen)

Principle of vibration generation:

magnetostriction /~~piezoelectricity~~/

Laboratory: **Institute of Water Problems**
of the Bulgarian Academy of Sciences,
Hydraulic Laboratory

1. Sketch of the sample (counter-sample) with dimensions and showing mounting

Specimen : cylindrical bolt (***sample size*** ϕ 16 ±0,01, ***thickness*** 6 mm)

2. Basic operational data

input power: ……	2000	W
oscillation frequency: ……	22 ± 0.2	kHz
oscillation amplitude(p-p): ……	25 ± 2.5	µm
standard temperature: ……	10 ÷ 100	˚C

open/~~pressurised~~ vessel

horn tip / sample gap: …… 0.5 ± 0.1 mm

vessel diameter: …… 90 mm height: …….. 140 mm

sample area subjected to damage: …….. 201.06 mm^2

other data: water depth in the vessel: 90 mm;
automatic control of oscillation amplitude;
automatic control of water temperature

designer:
Institute of Water Problems of the Bulgarian Academy of Sciences

manufacturer:
Industrial Electronics Works, Gabrovo, Bulgaria

INTERNATIONAL CAVITATION EROSION TEST

Laboratory Results Summarisation

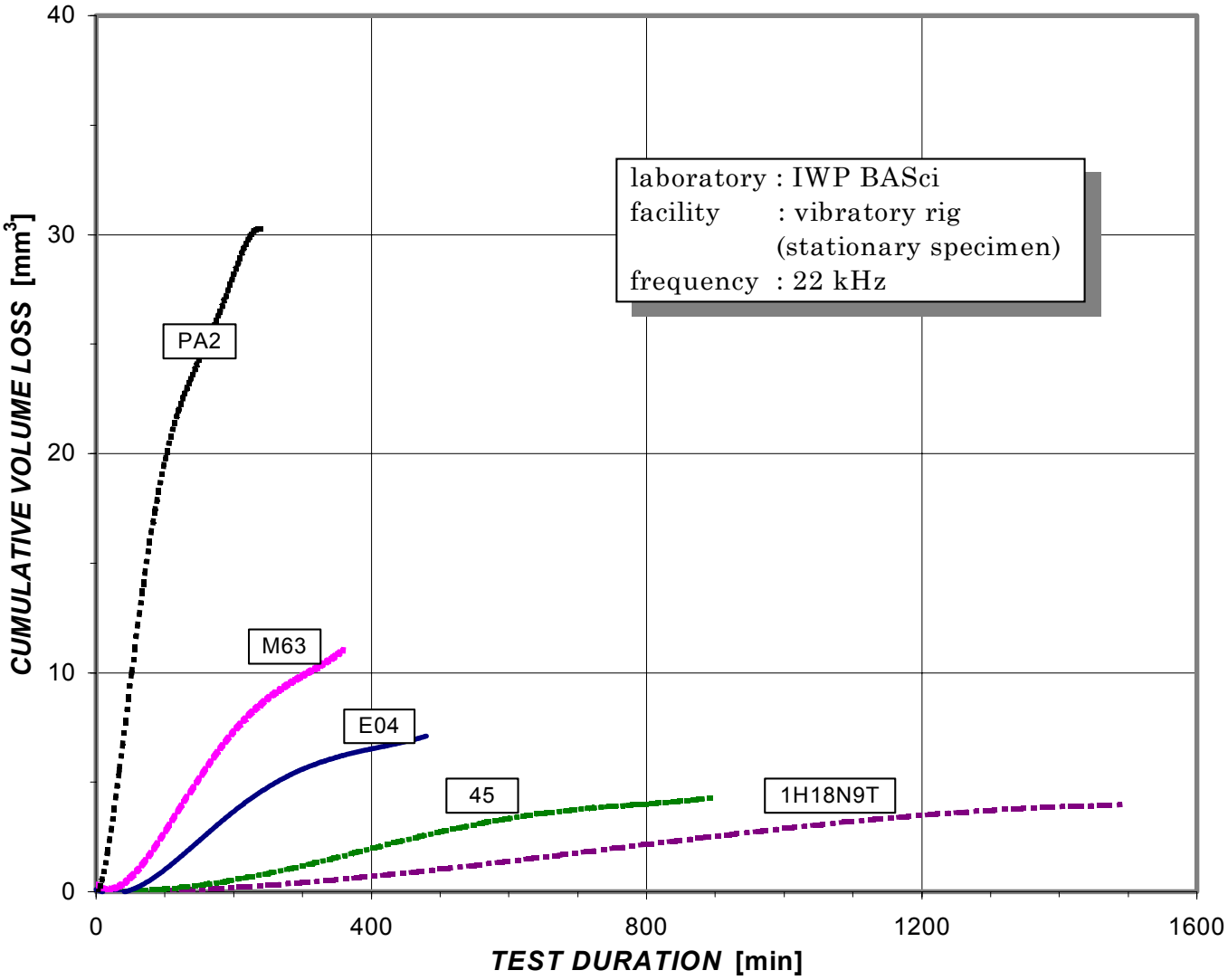
Laboratory: **INSTITUTE OF WATER PROBLEMS**
OF THE BULGARIAN ACADEMY OF SCIENCES
SOFIA, Bulgaria

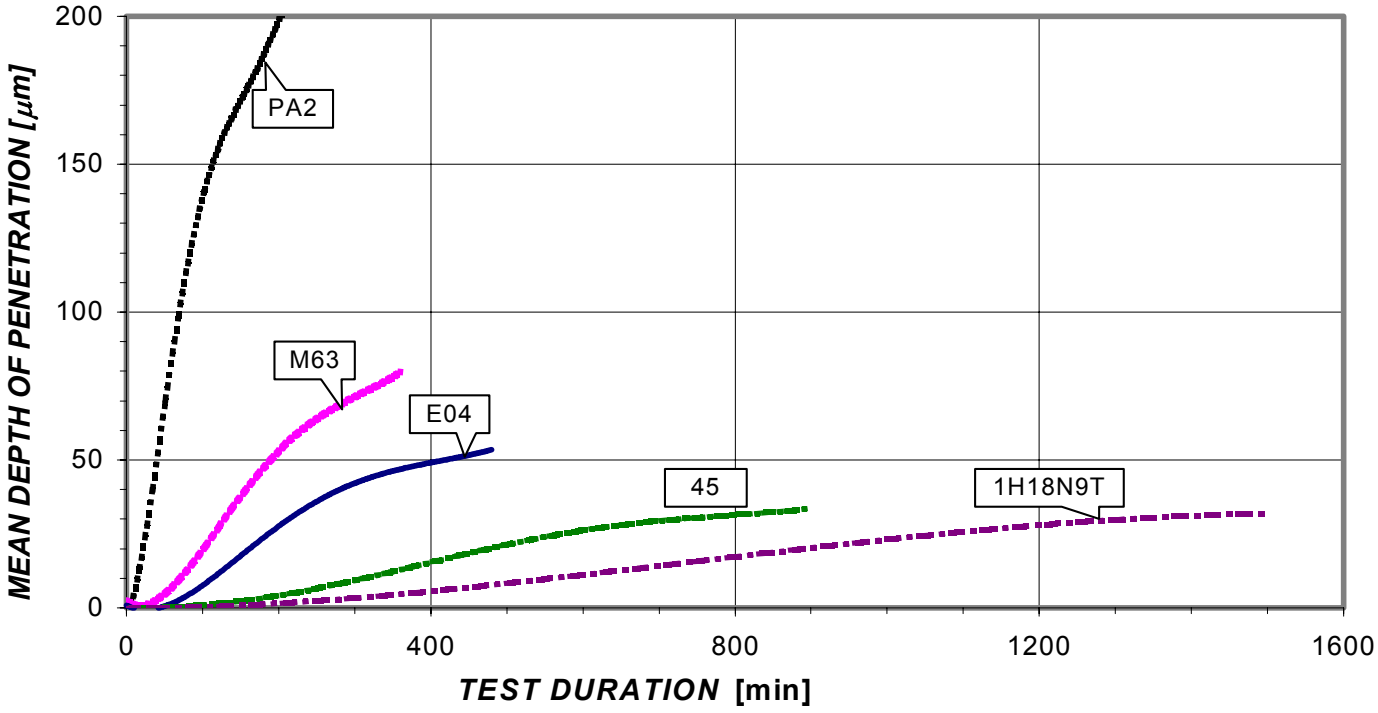
Facility: VIBRATORY RIG (stationary specimen)

oscillation frequency: 22 ± 0.2 kHz *horn tip/sample gap:* 0.5 ± 0.1 mm
amplitude: 25 ± 2.5 μm *impinged area:* 201.06 mm^2

working liquid: distilled water, 20 ˚C

material	*Test duration*	*Volume loss*	*Eroded area*	*Mean&Max Depth of Penetration*		*Incubation period*		*MDPR*	
						$\tau_{0.2}$	τ_{inc}	*max*	*ultimate*
	min	mm^3	mm^2	μm	μm	min	min	μm/min	
PA2	**240**	**30.35**	**141.75**	**214.10**	**-**	**10**	**16.91**	**0.920**	**0.320**
M63	240	8.52	138.25	61.63	-	20	64.35	0.231	0.140
E04	240	4.59	132.70	34.62	-	45	92.35	0.153	0.181
45	240	0.74	127.60	5.83	-	90	182.00	0.045	0.033
1H18N9T	240	0.31	124.70	2.49	-	150	-	0.005	0.005
M63	**360**	11.33	138.25	81.94	**-**	**20**	**64.35**	**0.231**	**0.140**
E04	360	6.20	132.70	46.68	-	45	92.35	0.153	0.075
45	360	1.61	127.60	12.65	-	90	182.00	0.045	0.043
1H18N9T	360	0.59	124.70	4.71	-	150	311.00	0.016	0.016
E04	**480**	7.05	132.70	53.14	**-**	**45**	**92.35**	**0.153**	**<0.035**
45	480	2.64	127.60	20.67	-	90	182.00	0.045	0.045
1H18N9T	480	0.97	124.70	7.76	-	150	311.00	0.020	0.020
45	**900**	4.28	127.60	33.55	**-**	**90**	**182.00**	**0.045**	**<0.002**
1H18N9T	900	2.55	124.70	20.47	-	150	311.00	0.021	0.021
1H18N9T	**1500**	**3.97**	124.70	31.86	**-**	**150**	**311.00**	**0.024**	**<0.009**


laboratory : IWP BASci
facility : vibratory rig
(stationary specimen)
frequency : 22 kHz
PA2
M63
E04
45
1H18N9T
CUMULATIVE VOLUME LOSS [mm3]
TEST DURATION [min]
0
10
20
30
40
0
400
800
1200
1600


PA2
M63
E04
45
1H18N9T
MEAN DEPTH OF PENETRATION [μm]
TEST DURATION [min]
0
50
100
150
200
0
400
800
1200
1600

INTERNATIONAL CAVITATION EROSION TEST

Laboratory Results Summarisation

Laboratory: **INSTITUTE OF WATER PROBLEMS**
OF THE BULGARIAN ACADEMY OF SCIENCES
SOFIA, Bulgaria

Facility: **VIBRATORY RIG (stationary specimen)**

oscillation frequency: 22 ± 0.2 kHz *horn tip/sample gap:* 0.5 ± 0.1 mm
amplitude: 25 ± 2.5 μm *impinged area:* 201.06 mm^2

working liquid: distilled water, 20 ˚C

Material: PA2 aluminium alloy

speci-men	*test duration*	*mass loss*	*volume loss*	*eroded area*	*Mean&Max Depth of Penetration*		*Incubation period* $\tau_{0.2}$	τ_{inc}	$MDPR_{max}$
no.	min	g	mm^3	mm^2	μm	μm	min	min	μm/min
1.	240	0.0799	29.651	140.9	210.44	-	10	13.86	1.83
2.	240	0.0836	31.043	142.6	217.70	-	10	13.93	1.91

Mean values

	240	0.0817	30.347	141.8	214.07	-	10	13.91	1.87

Enclosure

Results of hardness measurement

INTERNATIONAL CAVITATION EROSION TEST

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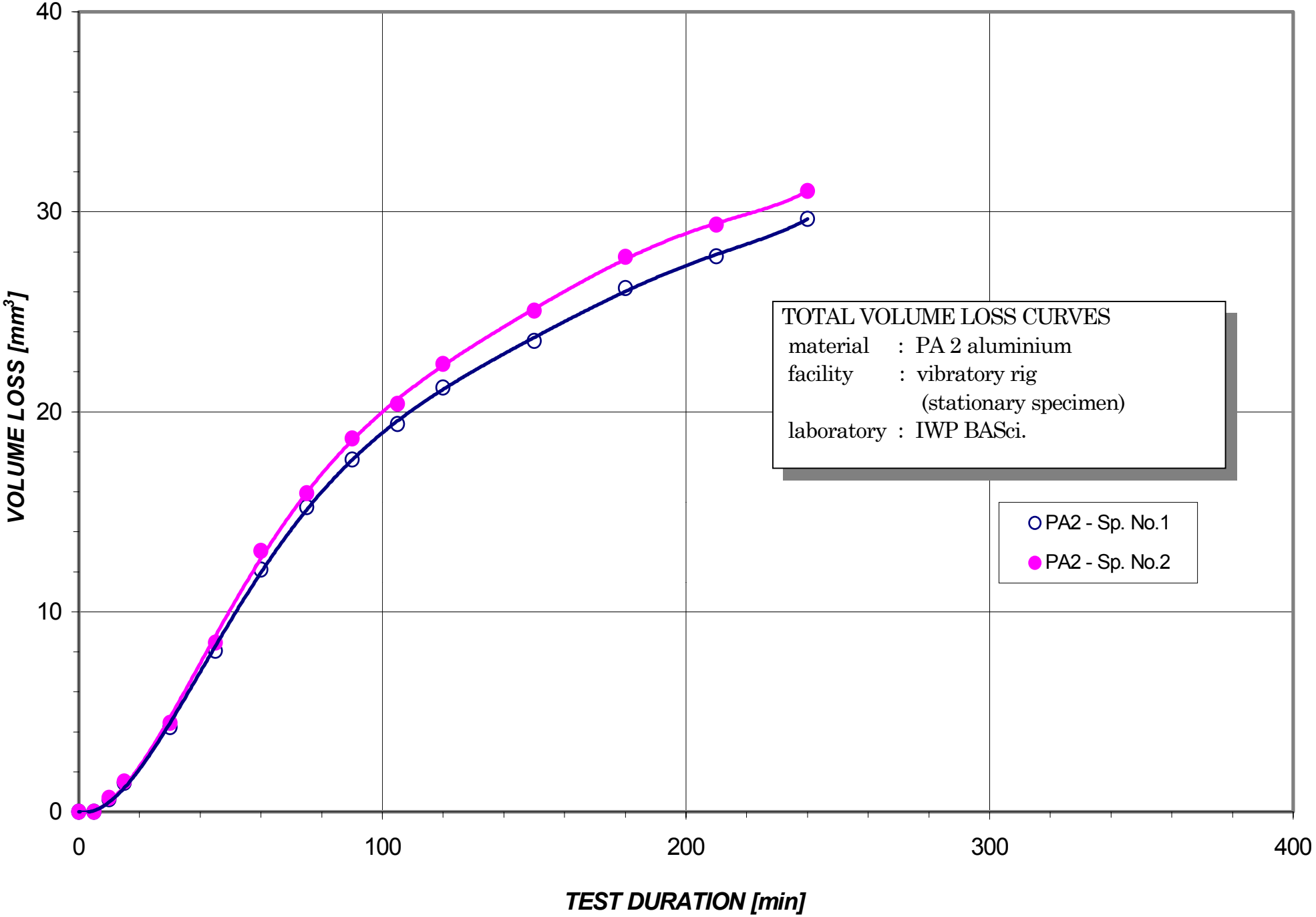
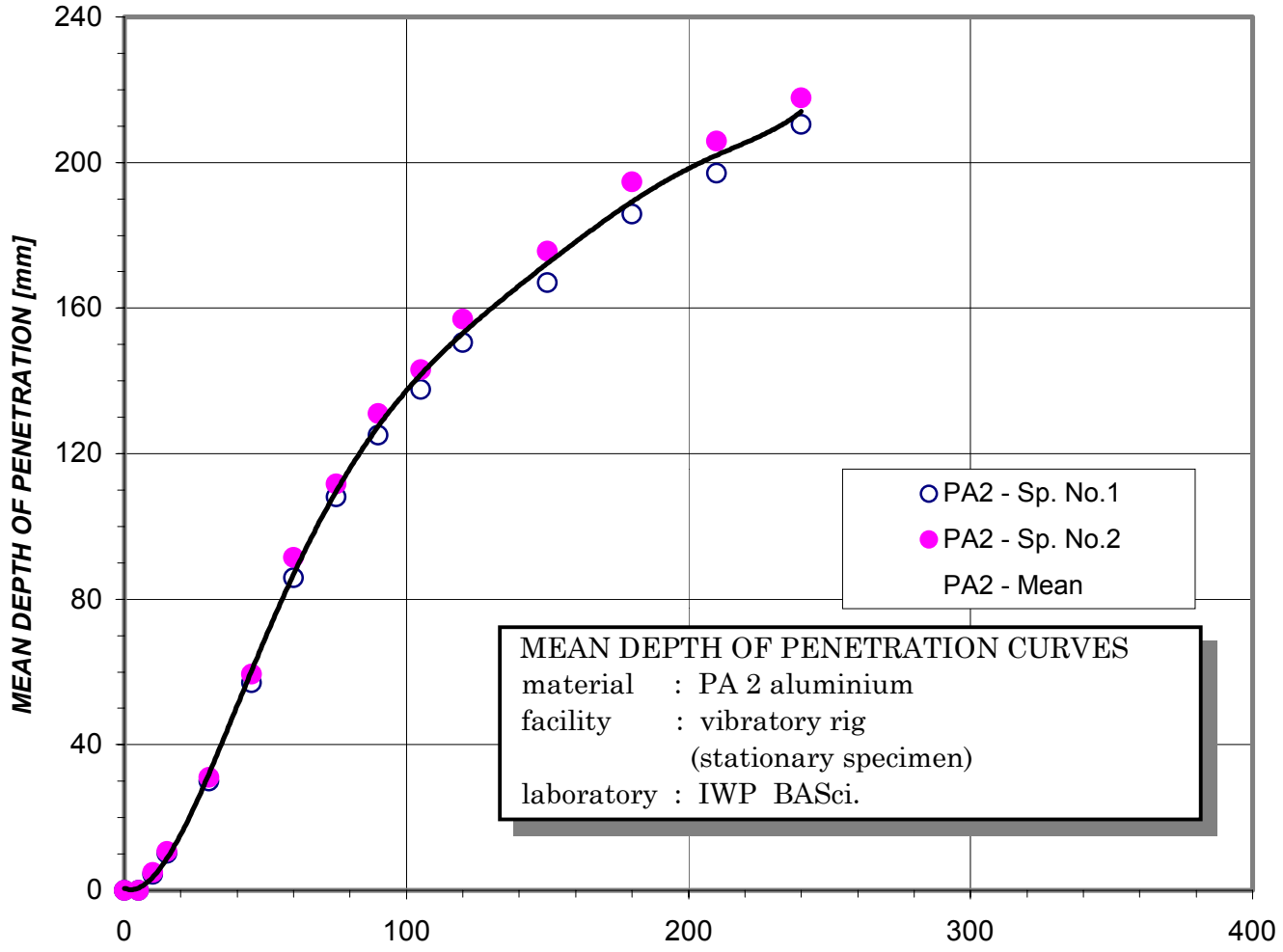
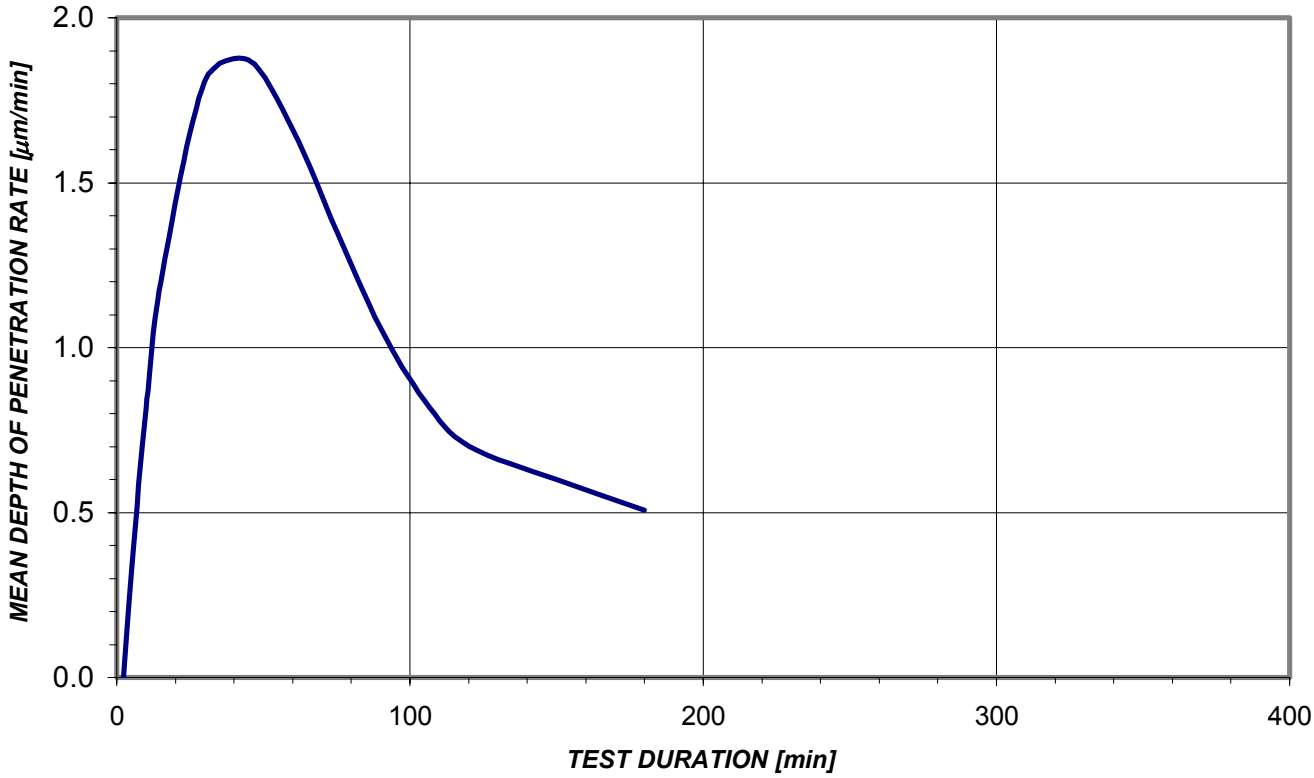


INTERNATIONAL CAVITATION EROSION TEST





VR 313

Enclosure

Results of Hardness Measurement
(according to Vickers)
Loading Force of 5 kG (HV_5)
Unit : kG/mm^2

PA2 aluminium alloy			
Specimen No.	*Distance from the sample centre*		
	0.0	0,2r	0,5r
1	83.80	85.10	83.20
2	84.40	85.90	84.30
mean values	84.10	85.5	83.75
base material	61,50 ÷ 62,80		

INTERNATIONAL CAVITATION EROSION TEST

Laboratory Results Summarisation

Laboratory: **INSTITUTE OF WATER PROBLEMS**
OF THE BULGARIAN ACADEMY OF SCIENCES
SOFIA, Bulgaria

Facility: **VIBRATORY RIG (stationary specimen)**

oscillation frequency: 22 ± 0.2 kHz *horn tip/sample gap:* 0.5 ± 0.1 mm
amplitude: 25 ± 2.5 μm *impinged area:* 201.06 mm^2

working liquid: distilled water, 20 ˚C

Material: M63 brass

speci-men	*test duration*	*mass loss*	*volume loss*	*eroded area*	*Mean&Max Depth of Penetration*		*Incubation period* $\tau_{0.2}$	τ_{inc}	$MDPR_{max}$
no.	min	g	mm^3	mm^2	μm	μm	min	min	μm/min
1.	360	0.0904	10.72	136.1	78.7	-	20	53.42	0.374
2.	360	0.0948	11.24	140.4	80.1	-	20	45.23	0.371

Mean values

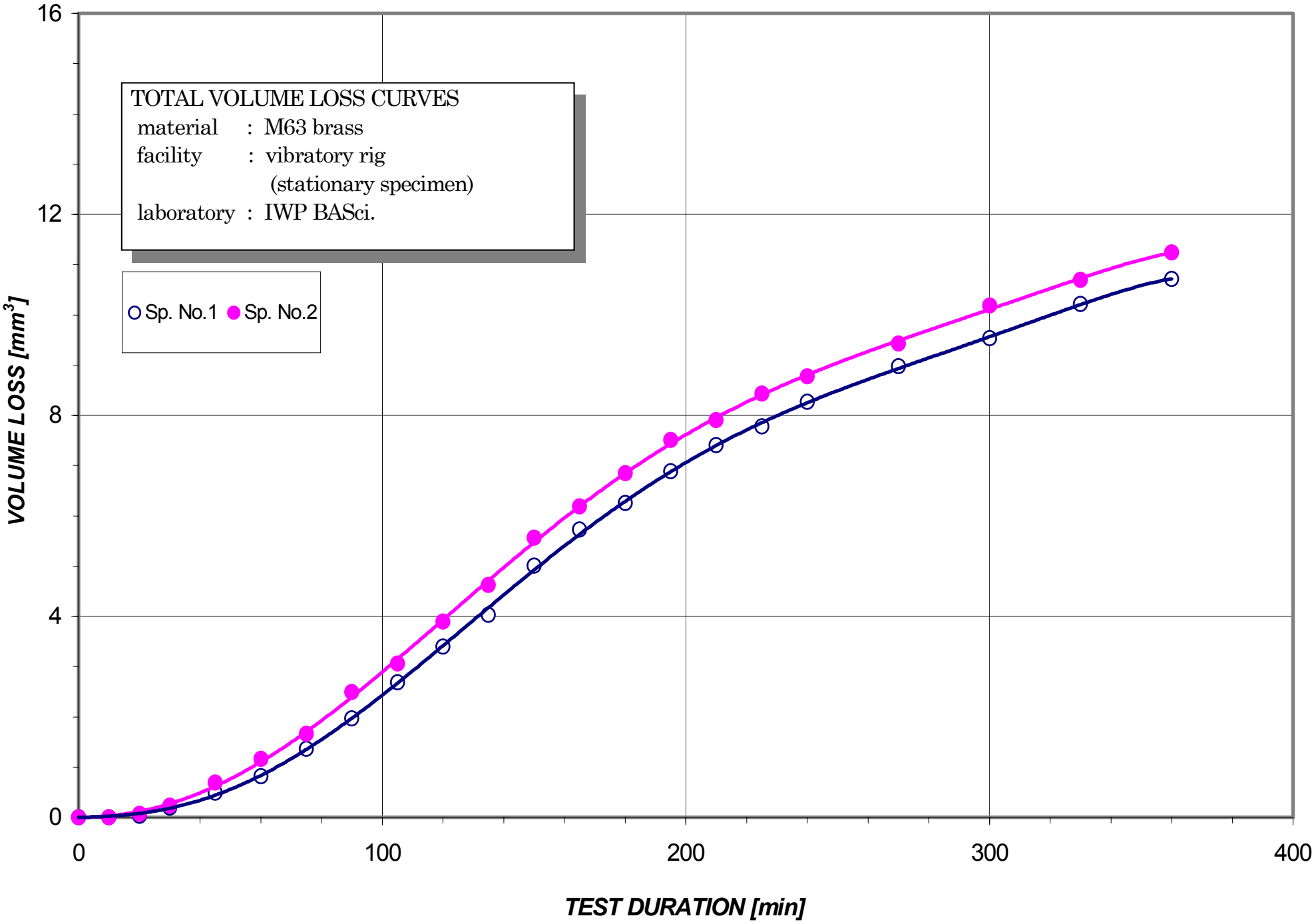
	360	0.0926	10.98	138.3	79.4	-	20	49.37	0.373

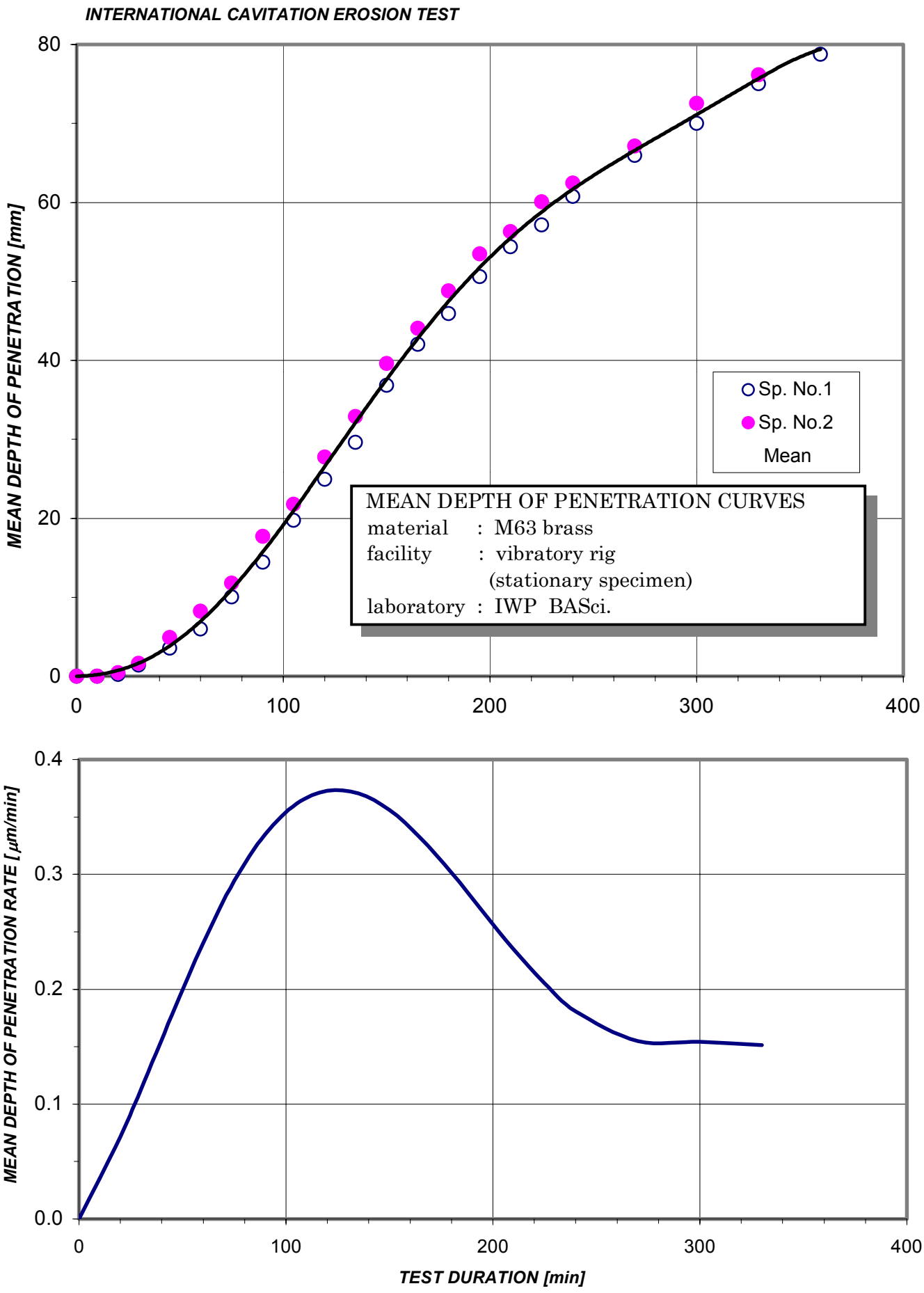
Enclosure

Results of hardness measurement

VR 316

INTERNATIONAL CAVITATION EROSION TEST




INTERNATIONAL CAVITATION EROSION TEST
MEAN DEPTH OF PENETRATION [mm]
80
60
40
20
0
0
100
200
300
400
Sp. No.1
Sp. No.2
Mean
MEAN DEPTH OF PENETRATION CURVES
material : M63 brass
facility : vibratory rig
(stationary specimen)
laboratory : IWP BASci.
MEAN DEPTH OF PENETRATION RATE [μm/min]
0.4
0.3
0.2
0.1
0.0
0
100
200
300
400
TEST DURATION [min]

VR 317

Enclosure

Results of Hardness Measurement
(according to Vickers)
Loading Force of 5 kG (HV_5)
Unit : kG/mm^2

M63 single phase brass			
Specimen No.	*Distance from the sample centre*		
	0.0	0,2r	0,5r
1	112.40	115.20	114.50
2	111.90	116.30	115.60
mean values	112.15	115.75	115.05
base material	72,20 ÷ 74,60		

INTERNATIONAL CAVITATION EROSION TEST

Laboratory Results Summarisation

Laboratory: **INSTITUTE OF WATER PROBLEMS**
OF THE BULGARIAN ACADEMY OF SCIENCES
SOFIA, Bulgaria

Facility: **VIBRATORY RIG (stationary specimen)**

oscillation frequency: 22 ± 0.2 kHz *horn tip/sample gap:* 0.5 ± 0.1 mm
amplitude: 25 ± 2.5 μm *impinged area:* 201.06 mm^2

working liquid: distilled water, 20 ˚C

Material: E04 Armco iron

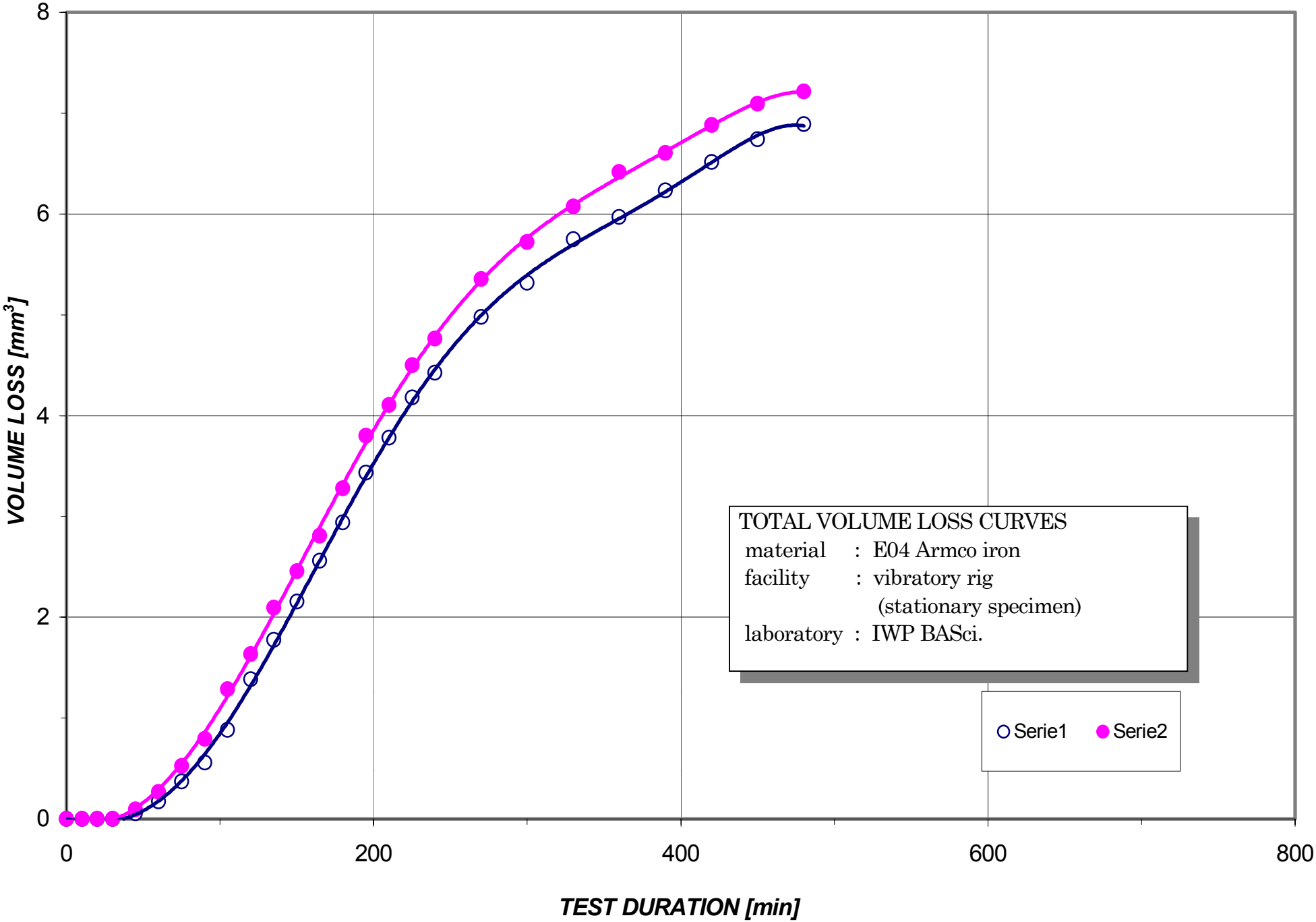
speci-men	*test duration*	*mass loss*	*volume loss*	*eroded area*	*Mean&Max Depth of Penetration*		*Incubation period* $\tau_{0.2}$	τ_{inc}	$MDPR_{max}$
no.	min	g	mm^3	mm^2	μm	μm	min	min	μm/min
1.	480	0.05410	6.89	131.1	52.55	-	45	73.57	0.2154
2.	480	0.05665	7.21	134.3	53.71	-	45	64.96	0.2152
Mean values									
	480	0.05538	7.05	132.7	53.13	-	45	69.26	0.2153

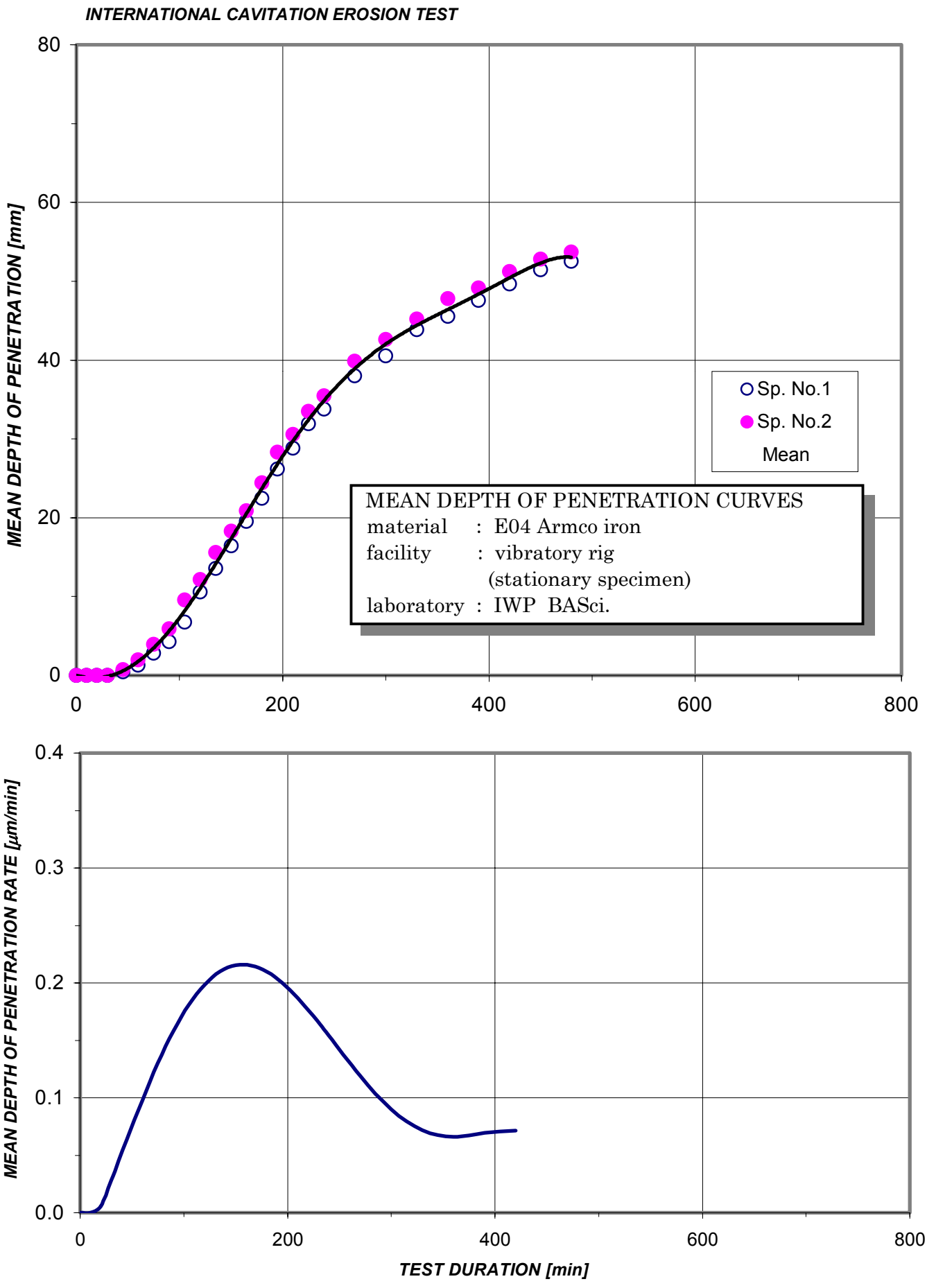
Enclosure

Results of hardness measurement

INTERNATIONAL CAVITATION EROSION TEST

VR 320




INTERNATIONAL CAVITATION EROSION TEST
MEAN DEPTH OF PENETRATION [mm]
80
60
40
20
0
0
200
400
600
800
Sp. No.1
Sp. No.2
Mean
MEAN DEPTH OF PENETRATION CURVES
material : E04 Armco iron
facility : vibratory rig
(stationary specimen)
laboratory : IWP BASci.
MEAN DEPTH OF PENETRATION RATE [µm/min]
0.4
0.3
0.2
0.1
0.0
0
200
400
600
800
TEST DURATION [min]

Enclosure

Results of Hardness Measurement
(according to Vickers)
Loading Force of 5 kG (HV_5)
Unit : kG/mm^2

E04 Armco iron			
Specimen No.	*Distance from the sample centre*		
	0.0	0,2r	0,5r
1	146.10	149.30	148.60
2	145.90	147.80	149.50
mean values	146.00	148.55	149.05
base material	98,20 ÷ 100,30		

INTERNATIONAL CAVITATION EROSION TEST

Laboratory Results Summarisation

Laboratory: **INSTITUTE OF WATER PROBLEMS**
OF THE BULGARIAN ACADEMY OF SCIENCES
SOFIA, Bulgaria

Facility: **VIBRATORY RIG (stationary specimen)**

oscillation frequency: 22 ± 0.2 kHz *horn tip/sample gap:* 0.5 ± 0.1 mm
amplitude: 25 ± 2.5 μm *impinged area:* 201.06 mm^2

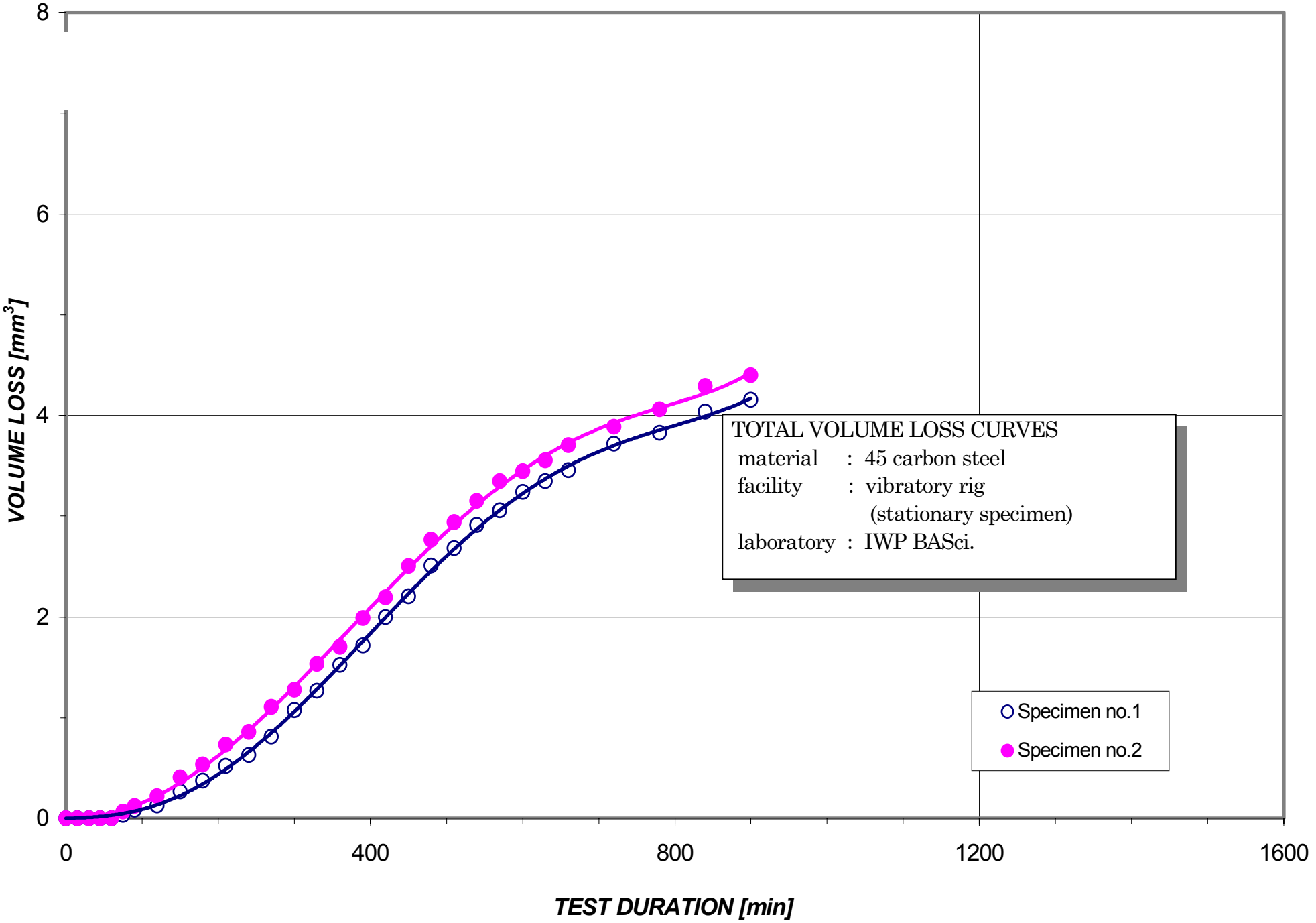
working liquid: distilled water, 20 ˚C

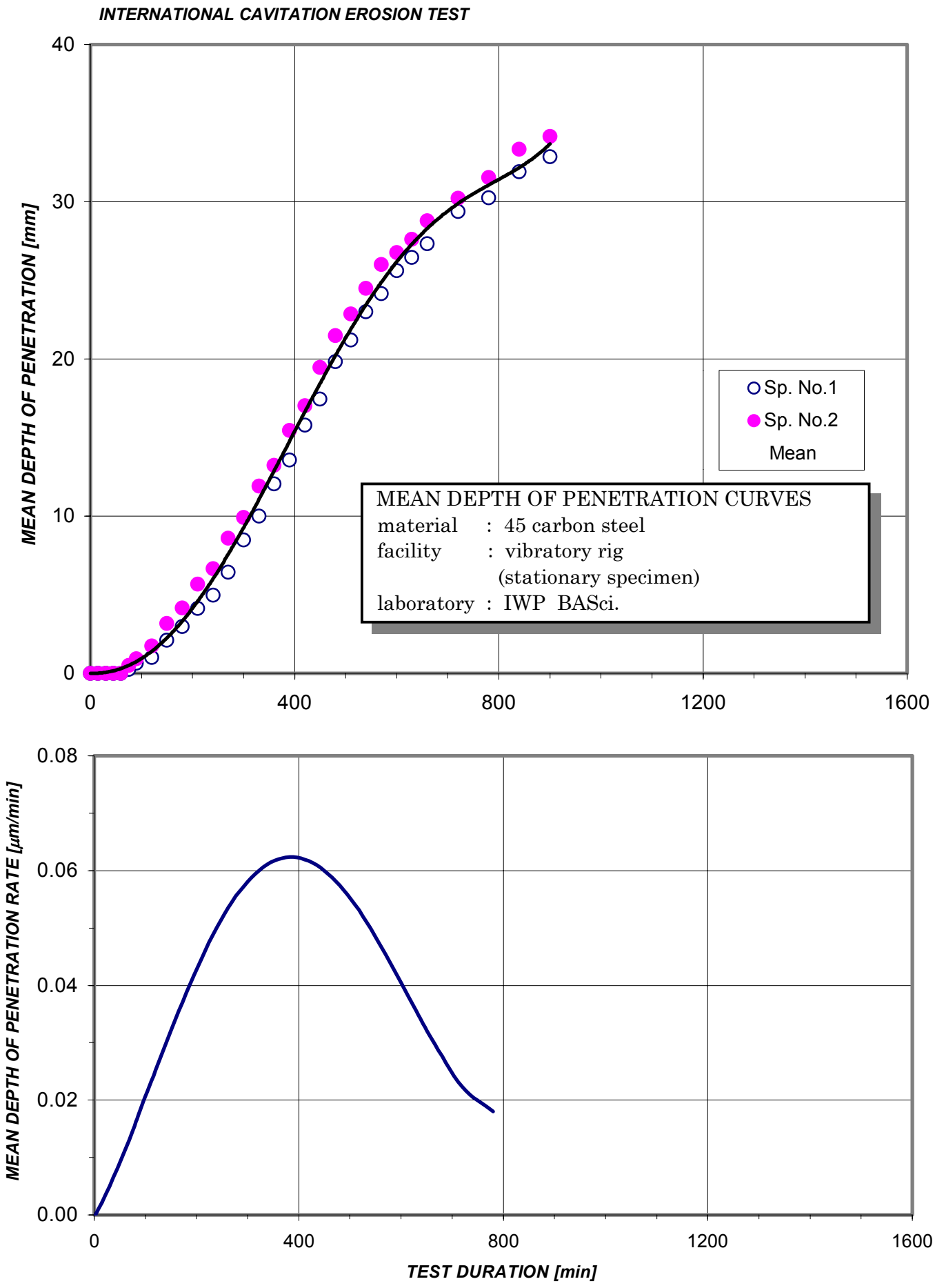
Material: 45 carbon steel

speci-men	*test duration*	*mass loss*	*volume loss*	*eroded area*	*Mean&Max Depth of Penetration*		*Incubation period* $\tau_{0.2}$	τ_{inc}	$MDPR_{max}$
no.	min	g	mm^3	mm^2	μm	μm	min	min	μm/min
3.	900	0.03270	4.16	126.5	32.85	-	75	175	0.06317
4.	900	0.03460	4.40	128.7	34.17	-	75	139	0.06162
Mean values									
	900	0.03365	4.28	127.6	33.51	-	75	157	0.06238

Enclosure

Results of hardness measurement


8
6
4
2
0
VOLUME LOSS [mm3]
0
400
800
1200
1600
TEST DURATION [min]
TOTAL VOLUME LOSS CURVES
material : 45 carbon steel
facility : vibratory rig
(stationary specimen)
laboratory : IWP BASci.
Specimen no.1
Specimen no.2


INTERNATIONAL CAVITATION EROSION TEST
MEAN DEPTH OF PENETRATION [mm]
40
30
20
10
0
0
400
800
1200
1600
Sp. No.1
Sp. No.2
Mean
MEAN DEPTH OF PENETRATION CURVES
material : 45 carbon steel
facility : vibratory rig
(stationary specimen)
laboratory : IWP BASci.
MEAN DEPTH OF PENETRATION RATE [μm/min]
0.08
0.06
0.04
0.02
0.00
0
400
800
1200
1600
TEST DURATION [min]

VR 325

Enclosure

Results of Hardness Measurement
(according to Vickers)
Loading Force of 5 kG (HV_5)
Unit : kG/mm^2

45 carbon steel			
Specimen No.	*Distance from the sample centre*		
	0.0	0,2r	0,5r
1	245.30	247.80	246.10
2	244.90	249.10	248.30
mean values	245.10	248.45	247.2
base material	179,60 ÷ 181,90		

INTERNATIONAL CAVITATION EROSION TEST

Laboratory Results Summarisation

Laboratory: **INSTITUTE OF WATER PROBLEMS**
OF THE BULGARIAN ACADEMY OF SCIENCES
SOFIA, Bulgaria

Facility: **VIBRATORY RIG (stationary specimen)**

oscillation frequency: 22 ± 0.2 kHz *horn tip/sample gap:* 0.5 ± 0.1 mm
amplitude: 25 ± 2.5 μm *impinged area:* 201.06 mm^2

working liquid: distilled water, 20 ˚C

Material: 1H18N9T stainless steel

specimen	*test duration*	*mass loss*	*volume loss*	*eroded area*	*Mean&Max Depth of Penetration*		*Incubation period* $\tau_{0.2}$	τ_{inc}	$MDPR_{max}$
no.	min	g	mm^3	mm^2	μm	μm	min	min	μm/min
5.	1500	0.03075	3.90	123.6	31.55	-	120	250	0.0309
6.	1500	0.03190	4.05	125.8	32.16	-	120	212	0.0305

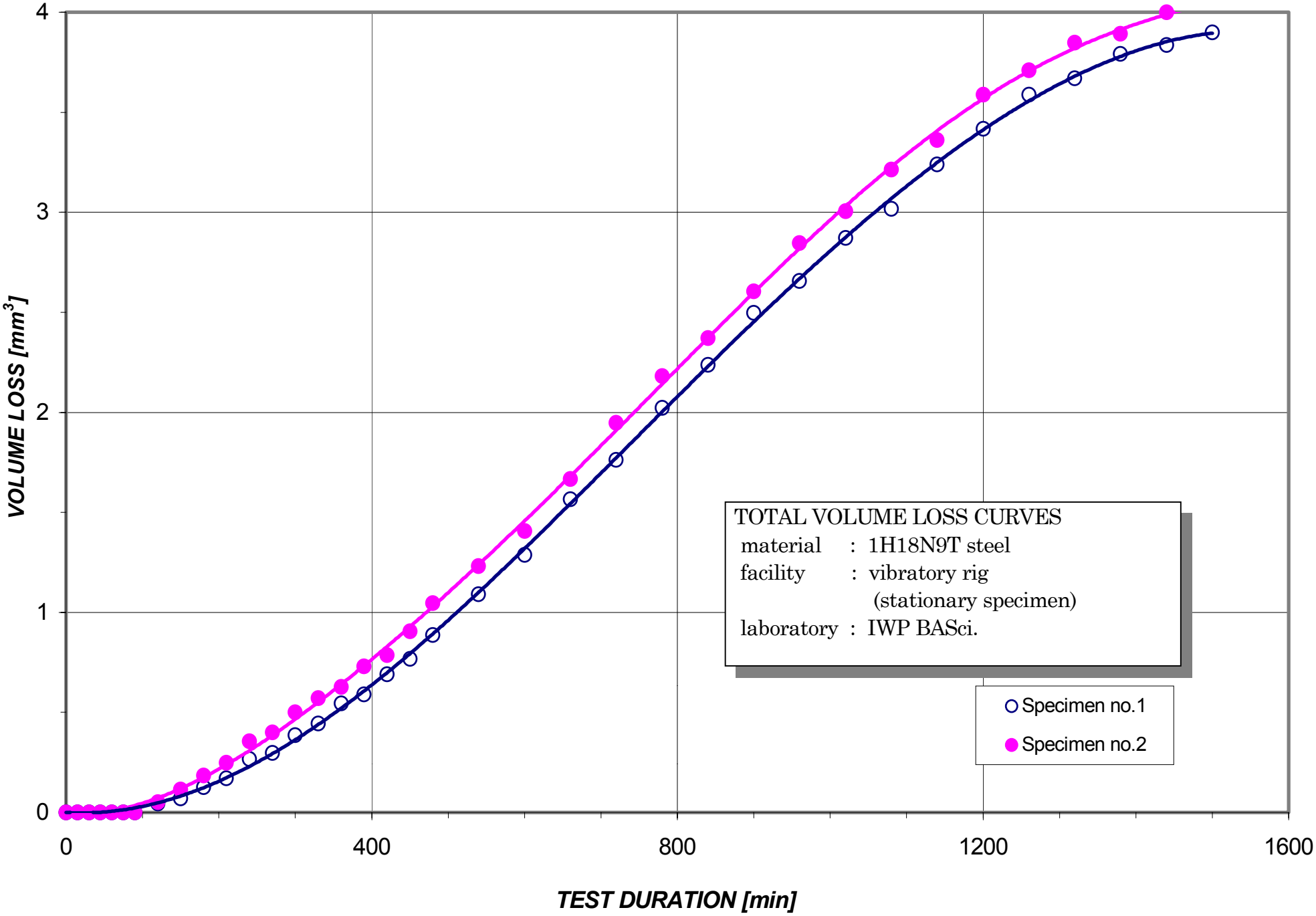
Mean values

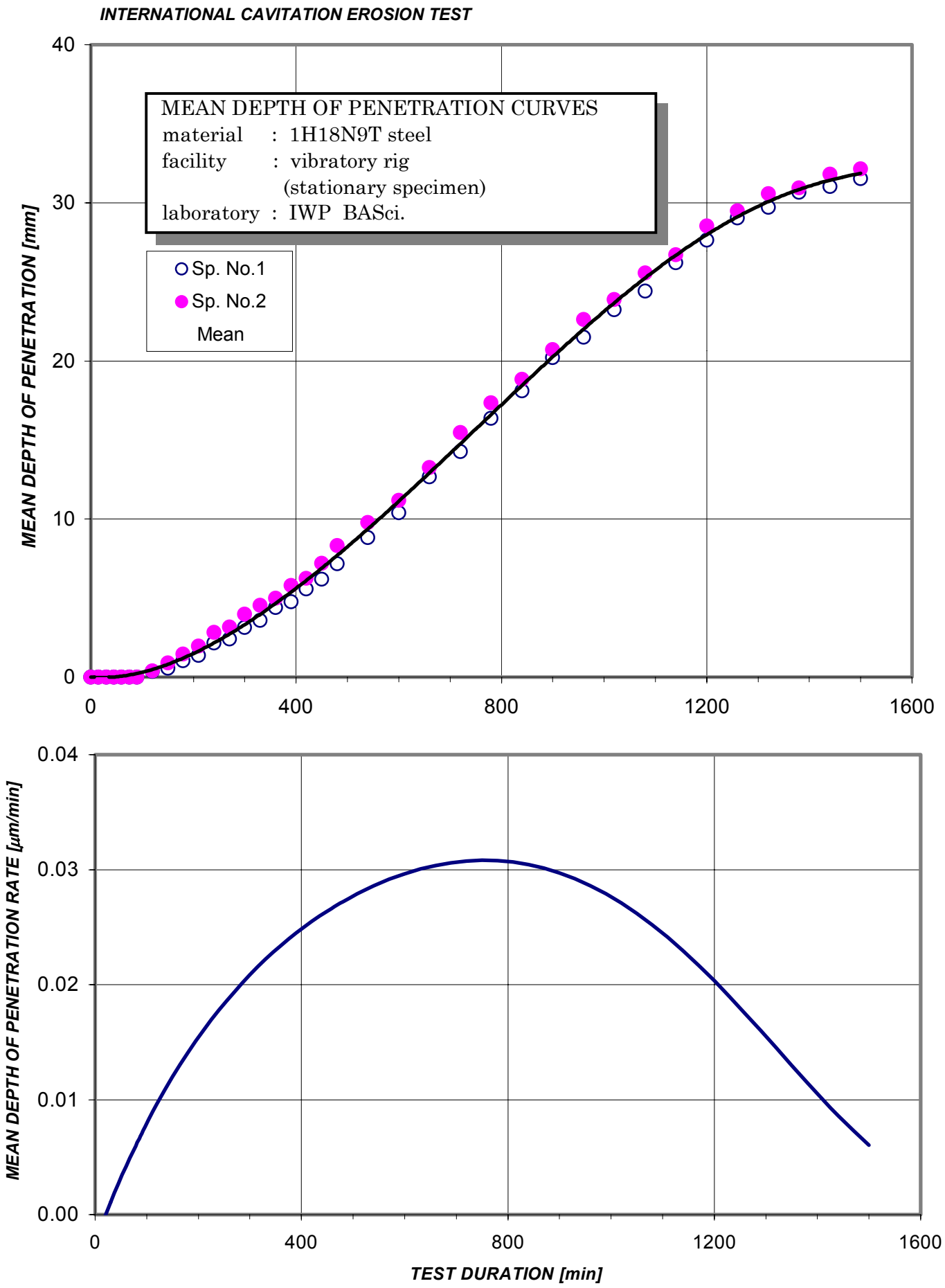
	1500	0.03133	3.97	124.7	31.85	-	120	232	0.0308

Enclosure

Results of hardness measurement

INTERNATIONAL CAVITATION EROSION TEST




INTERNATIONAL CAVITATION EROSION TEST
MEAN DEPTH OF PENETRATION CURVES
material : 1H18N9T steel
facility : vibratory rig
(stationary specimen)
laboratory : IWP BASci.
Sp. No.1
Sp. No.2
Mean
MEAN DEPTH OF PENETRATION [mm]
0
10
20
30
40
0
400
800
1200
1600
MEAN DEPTH OF PENETRATION RATE [µm/min]
0.00
0.01
0.02
0.03
0.04
0
400
800
1200
1600
TEST DURATION [min]

VR 329

Enclosure

Results of Hardness Measurement
(according to Vickers)
Loading Force of 5 kG (HV_5)
Unit : kG/mm^2

1H18N9T chromium nickel steel			
Specimen No.	*Distance from the sample centre*		
	0.0	0,2r	0,5r
1	260.40	264.70	262.80
2	261.30	262.50	265.90
mean values	260.85	263.60	264.35
base material	177,50 ÷ 179,80		