SESSION V

Induced Vibrations In the Pumps

Experiences with Sodium Pumps in the KNK
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S U M M A R Y

The paper describes the experiences concerning the vibrations character at one primary sodium pump. Furthermore it is explained the exchange of the rotor runner, the knowledges at the removed part and the operating experiences with the new mounted rotor runner.
By curves it is shown the vibrations behaviour between the old and the new rotor runner.

It will be tried to explain the facts of continual increased vibrations and the possibilities to remove them.

Karlsruhe, 10 Oct. 1986

Induced Vibrations in the Pumps

The KNK (Kompakte natriumgekühlte Kernkraftanlage= i.e. sodium cooled fast breeder reactor) has four pumps in service, two for the two primary circuits and two for the two secondary circuits. (pict. 1). The pumps in primary and secondary circuits aren't of the same dimension size. The spindle for the secondary circuit pump is shorter and the diameter is smaller. Also the operation temperatures are different. The pumps in the secondary circuits are in the cold part at a temperature during operation of 360° Celsius. Contrary to that the pumps in the primary systems are in the hot part with sodium temperatures of 520° C during operation. With the two secondary pumps and the first pump in primary circuit 1 we didn't have anydifficulties. The accumulated operation time for these pumps was about one-hundred-thousand hours for each pump up to this day. With the primary pump in the circuit 2 we have had difficulties concerning vibrations since the time of starting operation. In (pict. 2) there is represented the construction of the primary pump. Our problem with this pump has been a continuous increasing of vibrations. In (pict. 4) we are demonstrating the vibrations over the time with high revolutions per minute. From the manufacturer of the pumps was given the limit value for the vibrations until 300 µm. The vibrations will be registrated by two mounted receivers of a measurement device which submits the values to a computer.
In 1984 we have changed the rotor runner (pict. 3) after about 80 000 working hours and at a vibration level of 250 µm.
After demounting and cleaning of the parts we have controlled and measured them. Dimensional discrepancies we have found at the spindle (pict. 5). In the half length of the shaft we have noted a bending of abt. 0,4 mm. The measurements of wall thickness (pict. 6) have shown different values. In our opinion the continuous increasing of vibrations refers to two facts:

1. Residual stresses
2. Thermal creeping in connection with unbalance.

To point 1)
Most of residual stresses remaining after welding works at the shaft have been reduced by operation temperatures of abt. 520° C. In case an unbalance has arised in connection with the operation temperature this unbalance cannot increase more and vibrations would stay nearly constant.

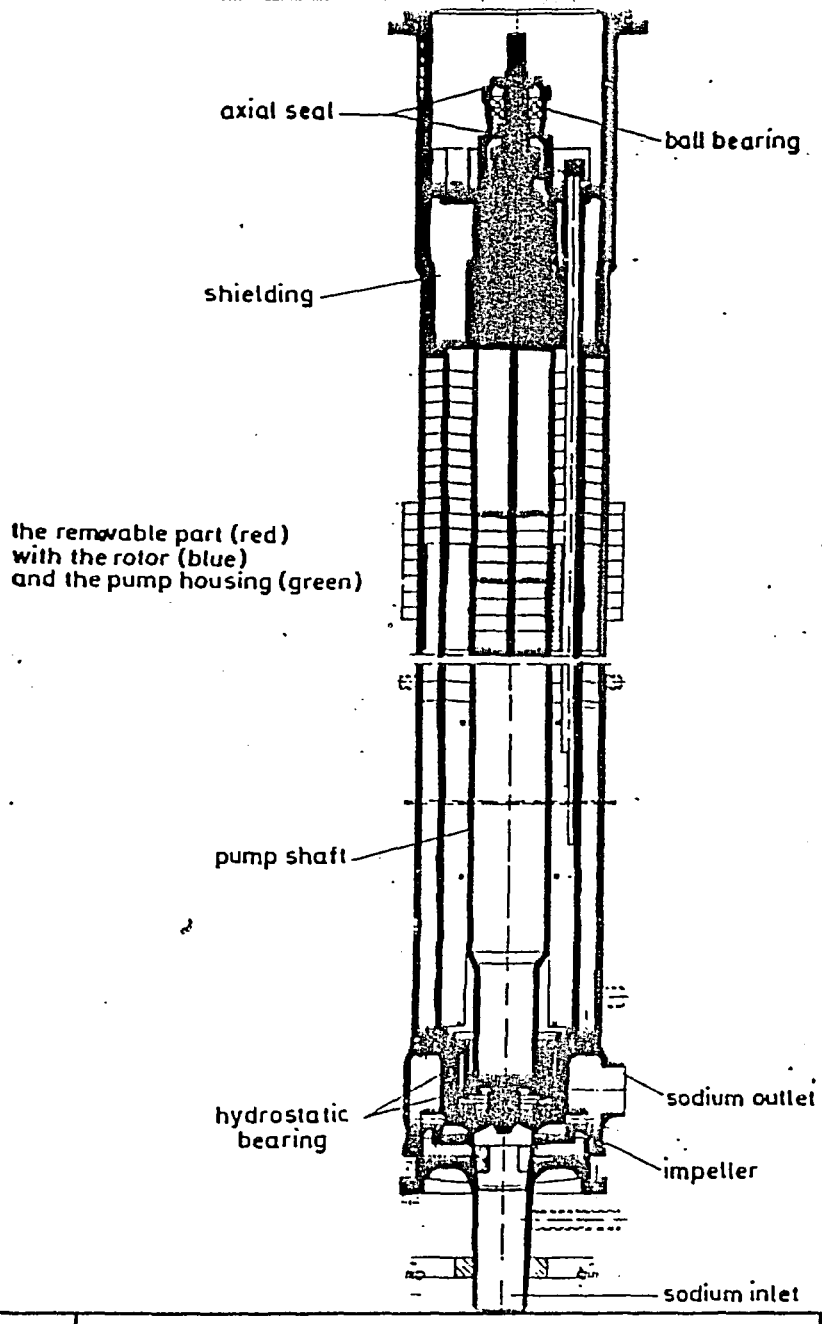
To point 2)
Thermal creeping resulting from different wall thickness or unbalance out of residual stresses will increase continually. We are of the opinion the problem with pump 2 must be referred to the above mentioned points.
In June 1984 we have made base measurings at the new installed rotor runner at a sodium temperature of 200° C and various revolutions (pict. 7).
A controlling measurement in 1986 has shown the same symptoms as received from the old rotor runner in May 1984. (pict. 7). Compare the curve of the old rotor runner recorded in May 1984 (pict. 8). The vibration values recorded during full power operation and 520°C sodium temperature are directly comparable with the values of the old rotor runner during the same operating conditions (pict. 9). Compare (pict. 9) with (pict.4).
The other curves in (pict. 9) have been recorded at a sodium temperature of 200 °C by hand measuring device at the measuring points 1, 11 and 13. (pict. 10). All these different measuring methods at different temperatures and measuring points confirm the above described tendency.

In all probability we have here the same defects on the new manufactured shaft as on the old shaft. Therefore we will have only still a short working life for the new shaft until the limit vibrations of 300 µm. For this reason we have to repair the removed part. The buckling is nearly exact over the greatest wall thickness. (Compare pict. 5 + 6).

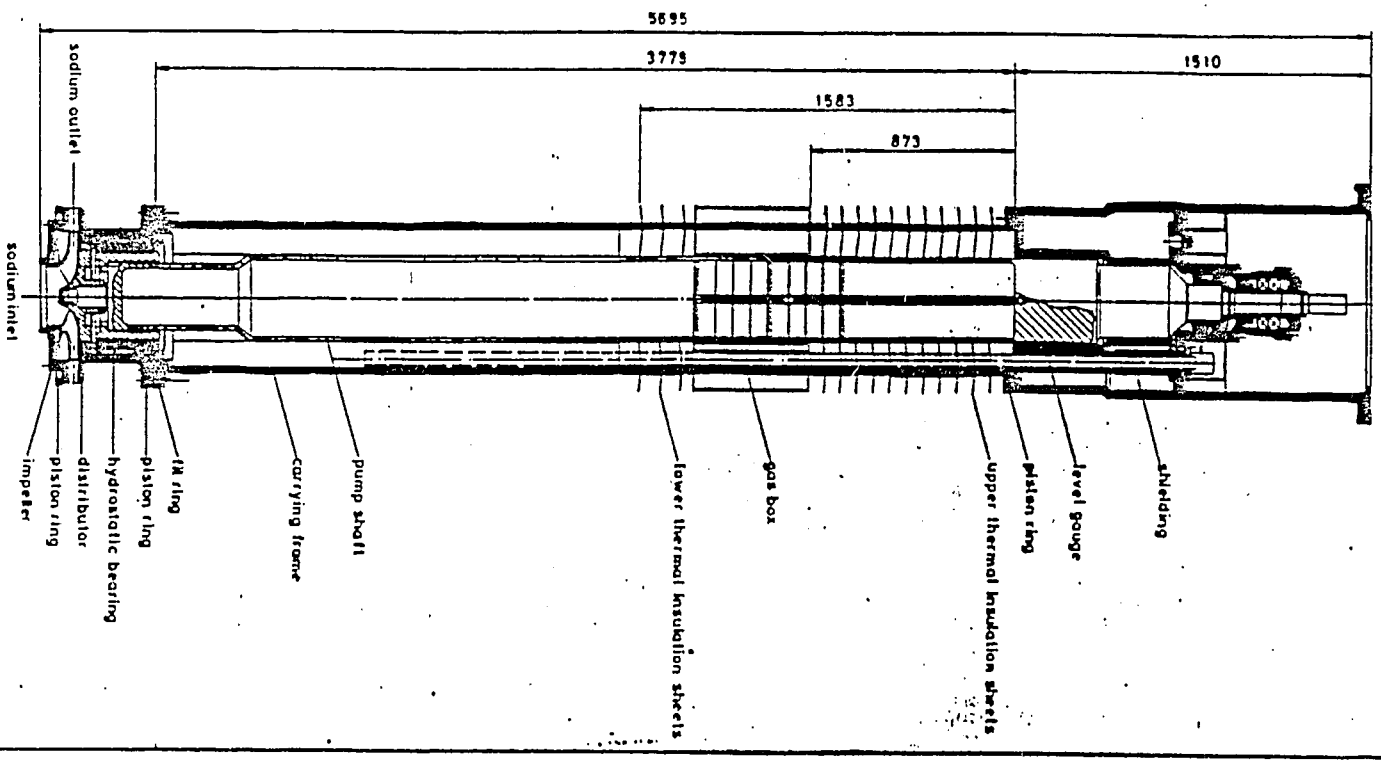
The irregularities will be removed by grinding.
We hope to get by this method equally wall thickness and reduced unbalance. By reduced unbalance the creeping behaviour will be improved. We also hope with this corrections to get the necessary quietness for the sodium pump in primary circuit 2.
In spring 1987 we intend to change the rotor runner and until end of next year we will know more, I hope.

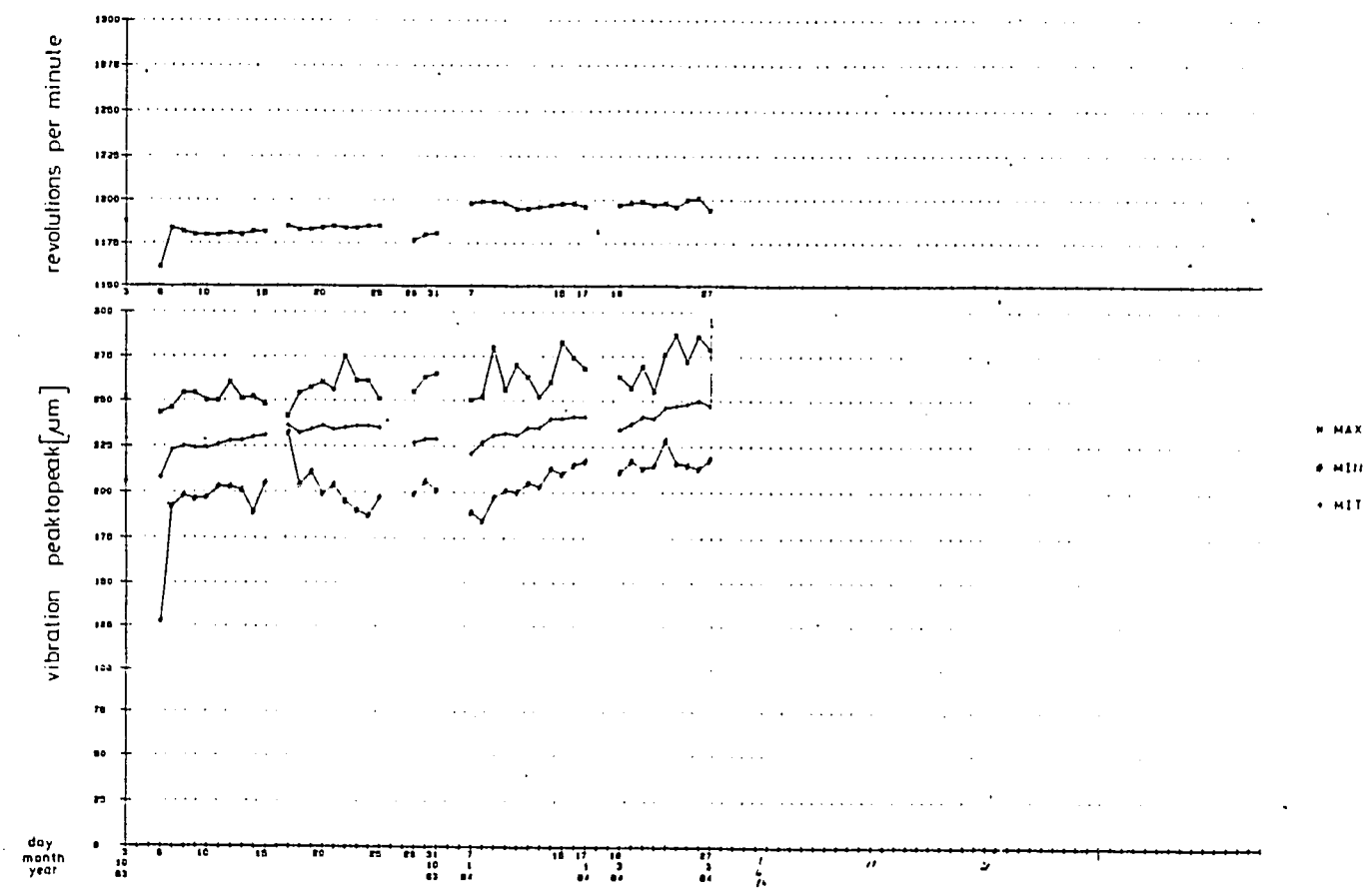
Leopoldshafen, Oct. 10, 1986

278

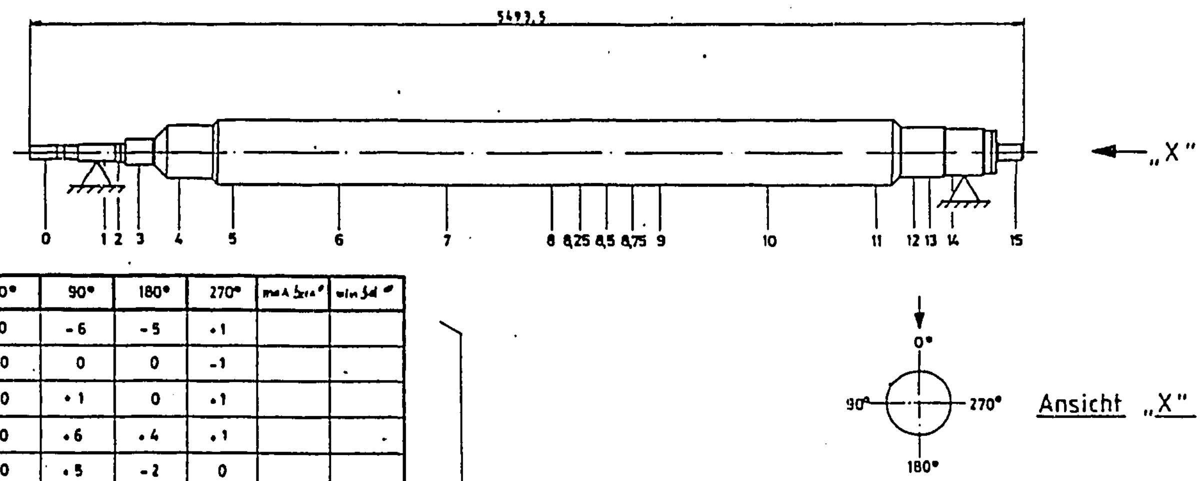


KBG	PRIMARY SODIUM PUMP	2





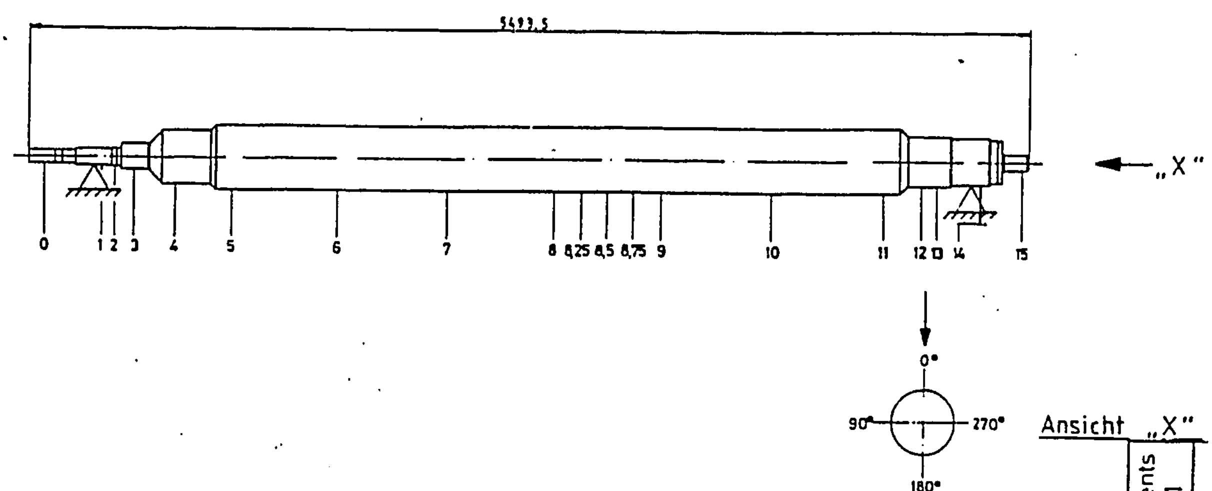
vibration measurements QP2D1 by full power ca 100%



meas point distance	Punkt	0°	90°	180°	270°	max Δs	min Δs
120	0	0	-6	-5	+1		
380	1	0	0	0	-1		
510	2	0	+1	0	+1		
600	3	0	+6	+4	+1		
815	4	0	+5	-2	0		
1160	5	0	+8	+1	-4		
1760	6	0	+14	-4	-17		
2360	7	0	+21	0	-24		
2960	8	0	+29	0	-32		
3110	8,25	0	+30	-6	-35		
3260	8,5	0	+32	-4	-37		
3410	8,75	0	+34	0	-36		
3560	9	0	+36	+1	-35		
4160	10	0	+28	+9	-23		
4760	11	0	+15	+2	-9		
4920	12	0	+11	+6	-2		
5020	13	0	-2	0	0		
5030	14	0	-3	0	+4		
5475	15	0	-7	-2	+10		

values in 1/100 mm

Änderung			
Bearb. 18.9.85 Fal	M 1:20	whirling arm control shaft (1A) QP2D1-H1	5
Kernkraftwerk, 7501 Leopoldshafen		Ersatz für: / ersetzt durch	

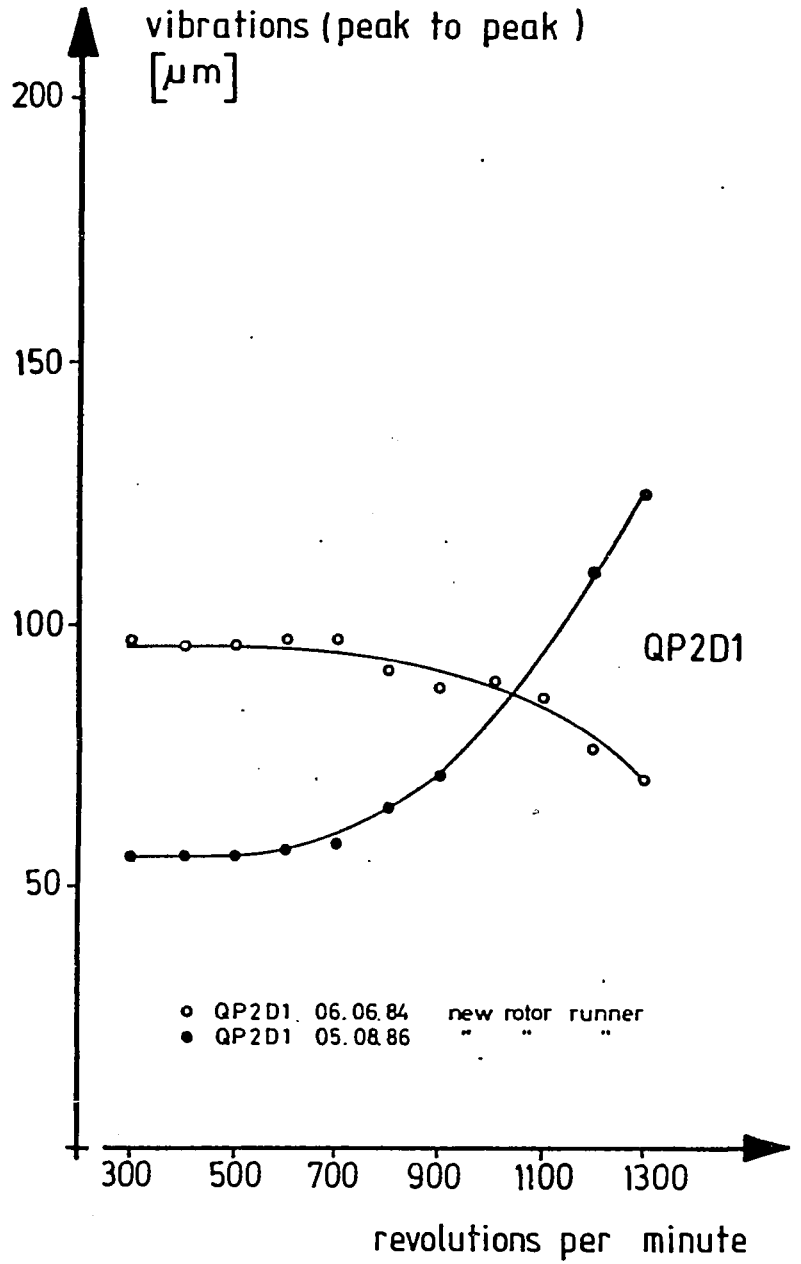


Meßabst.	Punkt	0°	45°	90°	135°	180°	225°	270°	315°
	6	20,0	20,1	20,2	20,2	20,3	20,0	19,9	19,9
	7	19,9	20,1	20,2	20,3	20,1	20,0	19,8	19,8
	8	20,0	20,1	20,3	20,4	20,3	20,0	19,9	19,7
	8,25	20,0	20,1	20,2	20,4	20,3	20,2	19,8	19,8
	8,5	20,0	20,2	20,4	20,4	20,3	20,1	19,8	19,9
	8,75	19,9	20,1	20,3	20,3	20,4	20,1	19,8	19,7
	9	19,9	20,2	20,3	20,3	20,2	20,0	19,8	19,8
	10	19,9	19,9	20,0	20,1	20,0	20,0	19,9	19,8
	11								
	12								
	13								
	14								

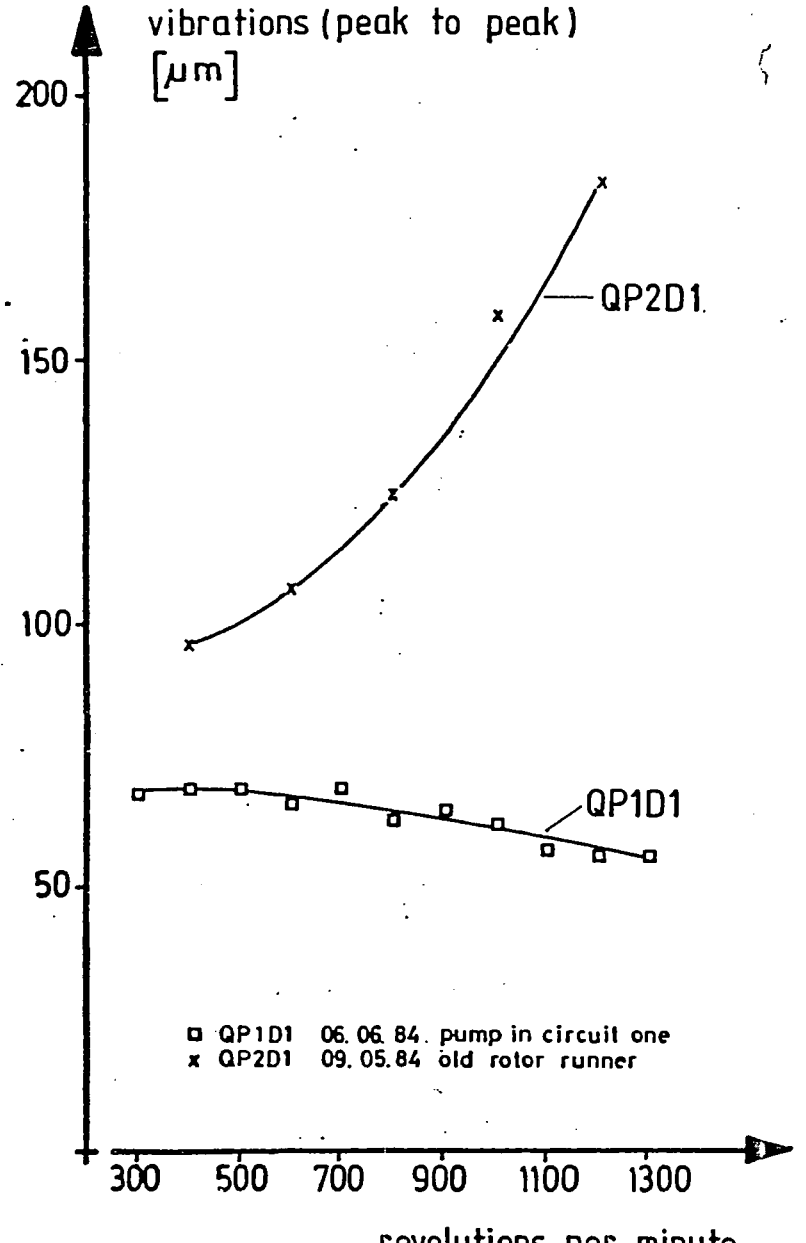
2 8 1

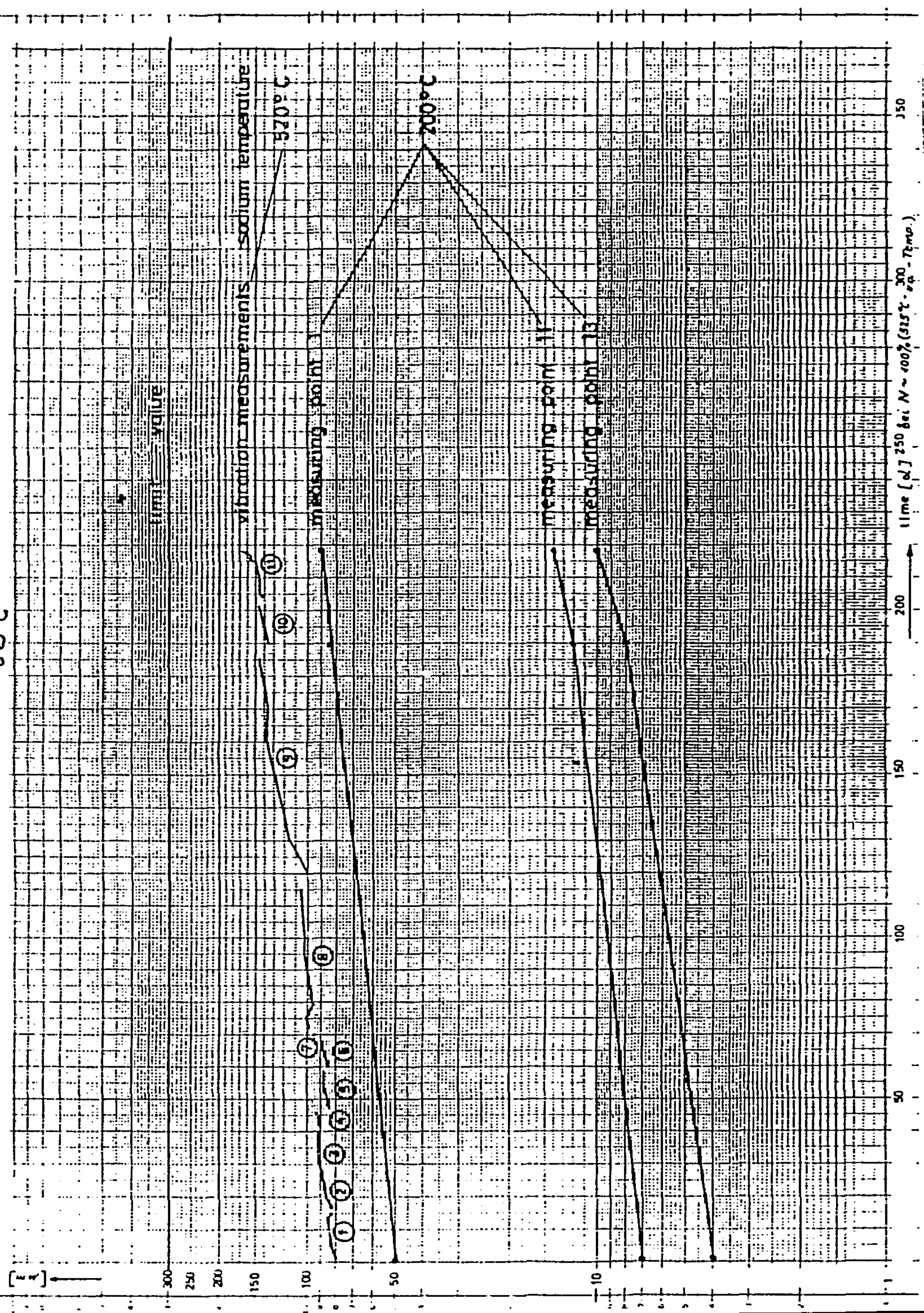
M 1:20	wallthickness measurements shaft (1A) QP2D1-H1

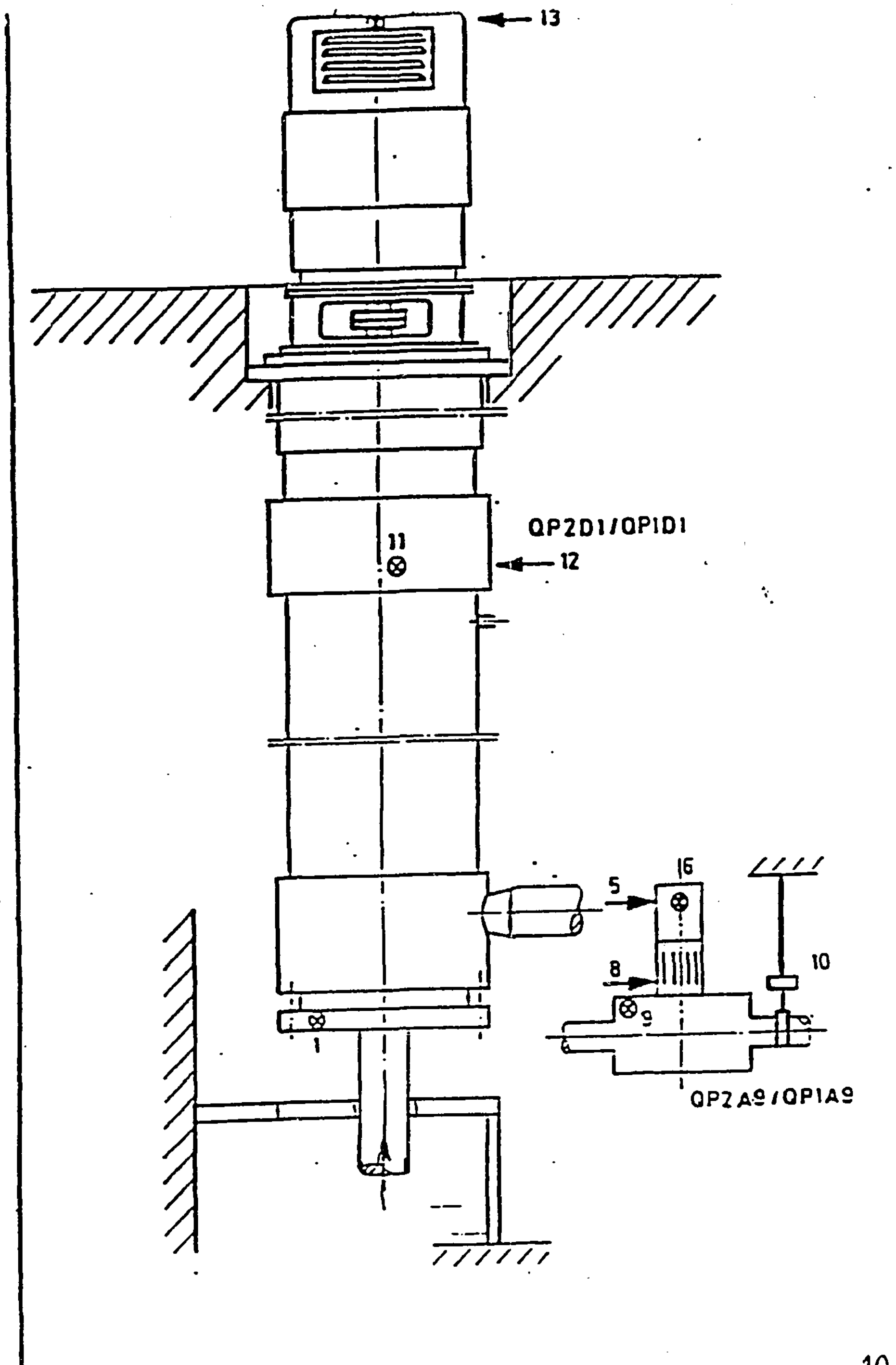
vibration measurements sodium temp. 200°C



vibration measurements sodium temp. 200°C




limit value
vibration measurements
sodium temperature
320° C
200° C
measuring point 1
measuring point 11
measuring point 13
time [d] 250 bei N ~ 100% (325°C - ... - Temp.)


13
QP2D1/QP1D1
12
11
16
5
8
9
10
1
QP2A9/QP1A9

10