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January 5, 1976

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Dr. B.K. Agarwala, Project Coordinator
 Hydrostatic Extrusion & Materials Synthesis
 National Physical Laboratory, Hillside Road
 New Delhi-110012, INDIA

Re: Binding-Ring breakage,
 Guide-Pin leaks, etc.

Dear Dr. Agarwala:

In ultra high pressure apparatus, particularly under heavy duty use such as you are undertaking, materials of construction are stressed almost to their ultimate limits. Consequently, one must be prepared for component failures, particularly of anvils and occasionally binding-rings.

Anvils through which the heavy electrical currents are applied are more subject to failure. Sometimes this failure is catastrophic and the shock wave produced leads to breakage of all the anvils. The current carrying anvils should be inspected for cracks almost every run and should be replaced when cracks first appear. The cracks are easily seen if the anvils are kept clean with a damp cloth as I have previously instructed. Cracks may also be felt by running a fingernail across the anvil faces.

The positioner (back insulated ring) rarely breaks. However, if you wish to have a spare or two, I must have an official purchase order. Their cost is \$1200.00 each f.o.b. Provo. Time must be allowed to obtain the alloy steel forgings, the heat treating, curing of the bonded fiber-glass resin and of course the machining operations. This would be about three months after receipt of an order.

With regard to the guide -pin located between rams one and two, you should obtain free motion by hoisting upwards on either base number one or two. The press is very heavy. The sliding parts fit closely. The weight of the press causes sufficient "sag" to produce binding which is readily overcome by the hydraulic rams in normal press operation but which is resisted by the relatively puny force of a man with a small wrench.

You need a permanent or portable overhead crane (hoist) for your high pressure equipment. A hoist of one-half ton capacity could probably take enough weight off the pins to free them. To lift the entire press you would need a four-ton hoist.

In answer to your last questions; (i) The press is OK to run. The guide pin is not too tight. Note the discussion above about the weight of the press. (ii) Lift upwards on bases 1, 2, or 5 as previously explained, (iii) Increase the retraction pressure to its original value of about 1500psi.

I hope the above will be helpful to you.

Sincerely,

H. Tracy Hall

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Telegram : NATPHYLAB
Phone : 587857

**Hydrostatic Extrusion & Material Synthesis Pilot Plant
NATIONAL PHYSICAL LABORATORY**

Hillside Road, NEW DELHI-110012.

Dr. B. K. Agarwala
Project Coordinator

Ref. No. AM/MW/449/75

Date, December 9, '75

Dear Prof. Tracy Hall,

I had written you a letter on December 2 from New York requesting you to send us the heat control and the rectifier unit, a voltmeter and an ammeter.

On coming here I have been told that the heat control and rectifier unit have since been delivered. The instruments had unfortunately been lying in local UNDP's office without anybody caring either to inform the NPL or deliver them by a personal messenger. I regret very much the inconvenience caused to you.

It will be very good of you if you could send the voltmeter and the ammeter also and send the bill for the ammeter to the UNDP (New York) for payment. The instruments may please be sent to Mr. J. Pellegrino who has kindly agreed to pouch them to the UNDP office in New Delhi. This will set the control console in perfect working order.

During my absence the press has developed a fault. The nature of the fault is described on the attached sheet. This is causing us grave concern. Right now what it means is that the retraction of the anvils is slow. But it may cause more serious trouble at a later stage and perhaps to a breakdown. I shall be very grateful if you please let me know what we shall do about it and how the fault can be rectified.

On your advice I had written to the Canadian firm to let us know the solvents that they could supply for laboratory experiments on diamond synthesis. I have not got a reply yet. Could you assist us in this ?

I am sure you have received my earlier letter in which I requested you to quote for a production type belt apparatus, and hope we shall get the quotations in about 6 weeks time. Prior to the quotations would it by any chance be possible to let us have the design of the cell so that we have an idea of the size of the graphite and solvent discs that we shall need and also calculate the quantity of diamond that we may obtain per run.

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Telegram : NATPHYLAB
Phone : 587857

**Hydrostatic Extrusion & Material Synthesis Pilot Plant
NATIONAL PHYSICAL LABORATORY**

Hillside Road, NEW DELHI-110012.

Dr. B. K. Agarwala
Project Coordinator

Ref. No.

- 2 -

Date.....

Your stay here was very instructive for us. Since we are new to the game there will be difficulties still and I do hope we shall continue to have your guidance, particularly with respect to the replacement of parts for the 200-ton press. In particular, we would request you to give us the spares as soon as they are required. Particularly important at this time is the rectification of the faults that have occurred.

With kind regards,

Yours sincerely,

Bhagwats

(B.K. AGARWALA)

Prof. H. Tracy Hall,
C/o H. Tracy Hall Inc.,
P.O. Box 7533,
University Station,
Provo, Utah 84601
U.S.A.

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The 200 ton press had been working satisfactorily since you left and we have made some progress in fixing up the pressure, time and power requirements to obtain various types of diamonds. On November 27, however some problems arose which are as follows :

1. We tried the graphite discs available at the NPL and different from the ones you had supplied. The pyrophyllite cell contained 6 graphite discs (0.040" thick x 0.249" dia) and 5 nickel discs (0.014" thick x 0.249" dia) with 0.003" Mo discs and thick current rings. The data of the run was as follows :-

Oil pressure :	5600 psi					
Time:	2 mts.	2½	3	3½	4	4½
Amperes:	560	580	600	660	680	700
Volts:	1.95	2.12	2.2	2.2	2.3	2.32

The variac was slowly taken to 560 amp. and 1.95 volt in 2 minutes.

At the last observation the current rose to 700 amp., 2.32 volt and then suddenly the ammeter and voltmeter needles came to zero.

This situation led us to a closer examination of the press and the sample. It was noticed that the WC anvils were OK but the binding ring in ram No. 3 (which is also one of the current carrying anvils) was cracked. This binding ring was replaced by a spare one sent by you.

The back insulated ring, in which the binding ring sits, also appeared to be cracked under the current carrying cable connector. On a closer microscopic examination it no longer appears to be a crack but a scratch made for some purpose with a sharp tool. Nevertheless in order to avoid taking risks we have exchanged this ring with that of ram No. 4 since this part had not been included in the spares list.

I am sending back the damaged binding ring to you under separate cover for your examination and comments through the UNDP. I would also appreciate having your opinion on the insulated backing ring as to whether you can recall having put, any mark on it anytime during the fabrication and assembly of the press. For any emergency arising now or later we would like to have two of these rings as spares. These may kindly be supplied under intimation to the UNDP and the bill be sent to them.

2. The aforesaid trial was run No. 53. Including 8-9 run with dummy cubes at about 2000 psi, we have till date made a total of about 62 runs with the press. After the 40th run, a

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slight seepage of oil was noticed at the hole, where the horizontal guide pin connecting rams 1 and 2 enters ram No. 1. The seepage gradually developed into a leak at the time of retraction until at the end of run no. 53 we thought it advisable to replace the guide pin seal in ram No. 1. For this purpose the procedure outlined by you was followed. The "stopper" blocks at the back of ram cylinders were taken off and the rams retracted gradually. The pin wrench was fastened to the pin and we moved it up and down at the same time pushing the pin to ram No. 2. Initially the pin moved freely but very soon jammed up and no matter how hard we tried, it just ~~not~~ ^{would} move up and down or sideways. At this point the backup washer fitted with O-ring in the pin in ram No. 1, just peeped out of the hole. We pried it out with a sharp needle. The O-ring was apparently undamaged. Since the pin did not come out of the ram No. 1, replacement of the back-up washer was not possible. So this end of the pin now carries only an O-ring. We closed up everything and ran the press. The oil no more leaks but to play safe we are running it at a lower retraction pressure (about 600 psi). The pin is still too tight to be moved by the wrench.

All the other pins are behaving as they ought to. In the samples subsequently pressed we do not notice any apparent assymetry which would indicate any probable misalignment of the rams which would cause the pin to become tight. I have explained the situation in some detail to invite your opinion on the following points in this connection:

- (i) Is it safe to run the press in this condition with horizontal guide pin between ram 1 and 2 too tight ?
- (ii) What do we do to move it if any of pin-seals has to be replaced subsequently?
- (iii) Can we keep the retraction oil pressure as low as 600 psi without inviting any further trouble ?

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