



**Drawing of Titanium
for
BROWN EUROPE**

HETRAN Inc.
70 Pinedale Industrial Road
Orwigsburg, PA 17961 U.S.A.

HETRAN Engineering GmbH
Schelpmiser Weg 8, D-33609 Bielefeld,
Germany

Major Pre-Conditions

Description	Value
Grades	Ti alloy (TA6V) / Ti (grade #5)
Tensile strength, max.	1,050 MPa
Ingoing diameter	7 – 16 mm
Coil OD, approx.	1,000 mm
Coil weight	50 – 300 KG

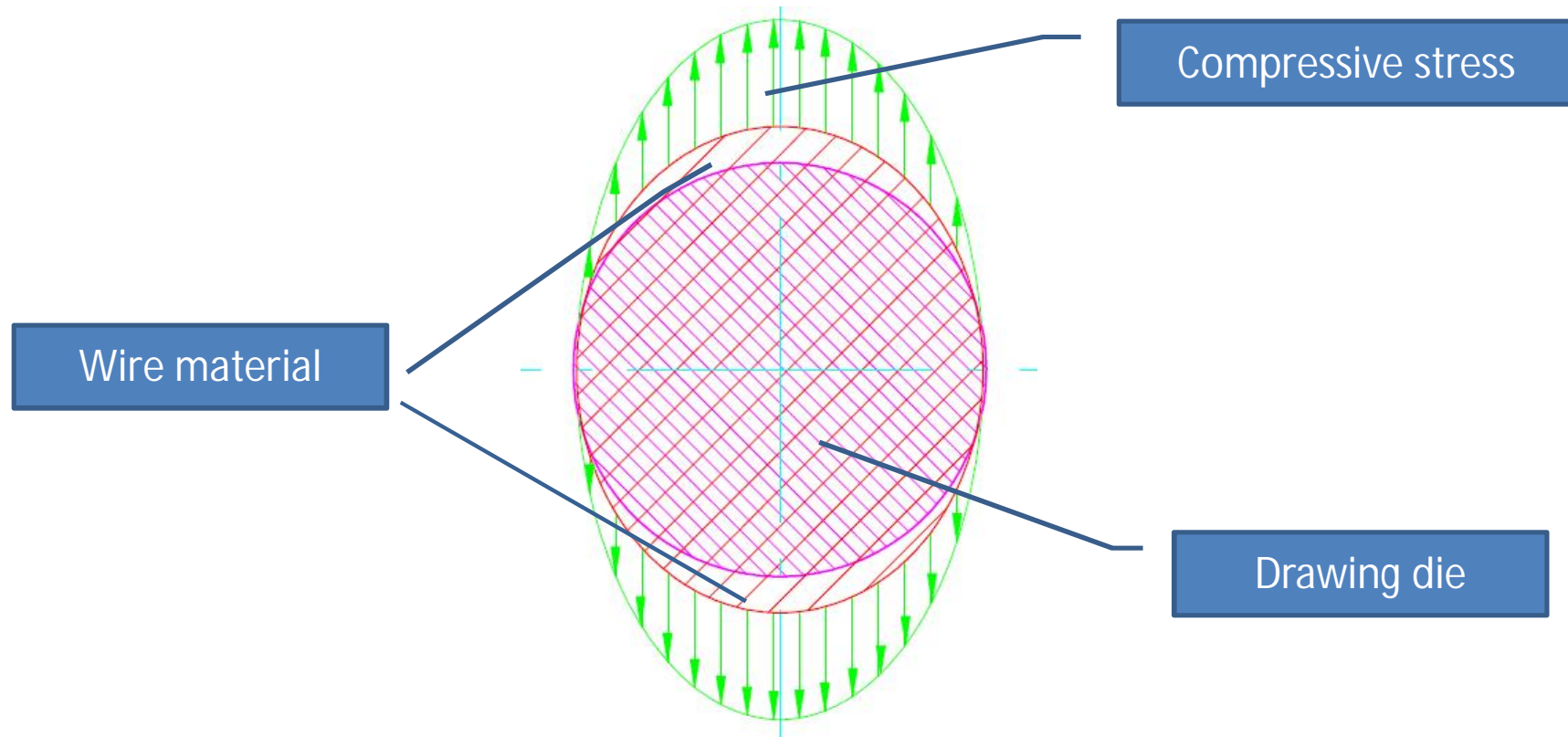
Technical Data Inverted Draw Bloc, Type IDB-05

Description	Value
Drive power	90 kW
Pulling force, max.	15 Tons
Reduction rate	10% – 25% (max. 30% possible)
Process temperature	100°C (max. 200°C possible)
Design speed	5 – 25 mpm (max. 30 mpm possible)
Drawing lubricant	Moly-disulfide (MoS ₂)
Capstan / OD of coil, approx.	900 mm / 1,000 mm
Working direction	Left to right (seen from operator side)

Comparison Drawing / Shaving Titanium

Drawing	Rotational Shaving
Diameter reduction and achievement of a certain diameter tolerance	Diameter reduction and achievement of a certain diameter tolerance
Surface defects are reduced in depth and elongated, but not removed (i.e. wire must be shaved and/ or grinded)	Surface defects are more or less removed, but peeling texture is visible (i.e. wire must be belt grinded)
Surface quality depends on lubricant, material, drawing die etc., a targeted surface roughness is difficult to achieve, therefore a final grinding is necessary	Surface quality depends on material, tools, speed etc., mostly combined with a following belt grinder for achieving a targeted surface roughness
Depending on the reduction speed range typically is between 10-25 m/min	Depending on cutting depth speed range typically is between 5-15 m/min

Effect Of Roundness in the Drawing Die



Improper roundness of the ingoing wire leads to an uneven resp. too high compressive stress at the peak areas in the drawing die and following hereof to a high risk of wire breaks or surface defects

Process Sequences

Wire with proper roundness



- After drawing a good roundness and diameter tolerance for the next shaving process is achieved, therefore
- Less material has to be removed at later shaving or grinding
- Hardened boundary layer from drawing is mostly removed by shaving
- Final stage grinding gives optimum surface roughness

Wire with improper roundness



- Avoiding cracks in the drawing die dia.-tolerance and roundness first have to be improved by shaving
- Hardened boundary layer from drawing remains
- Final stage grinding gives optimum surface roughness

Lubricant Application Methods

A) Offline Lub Application

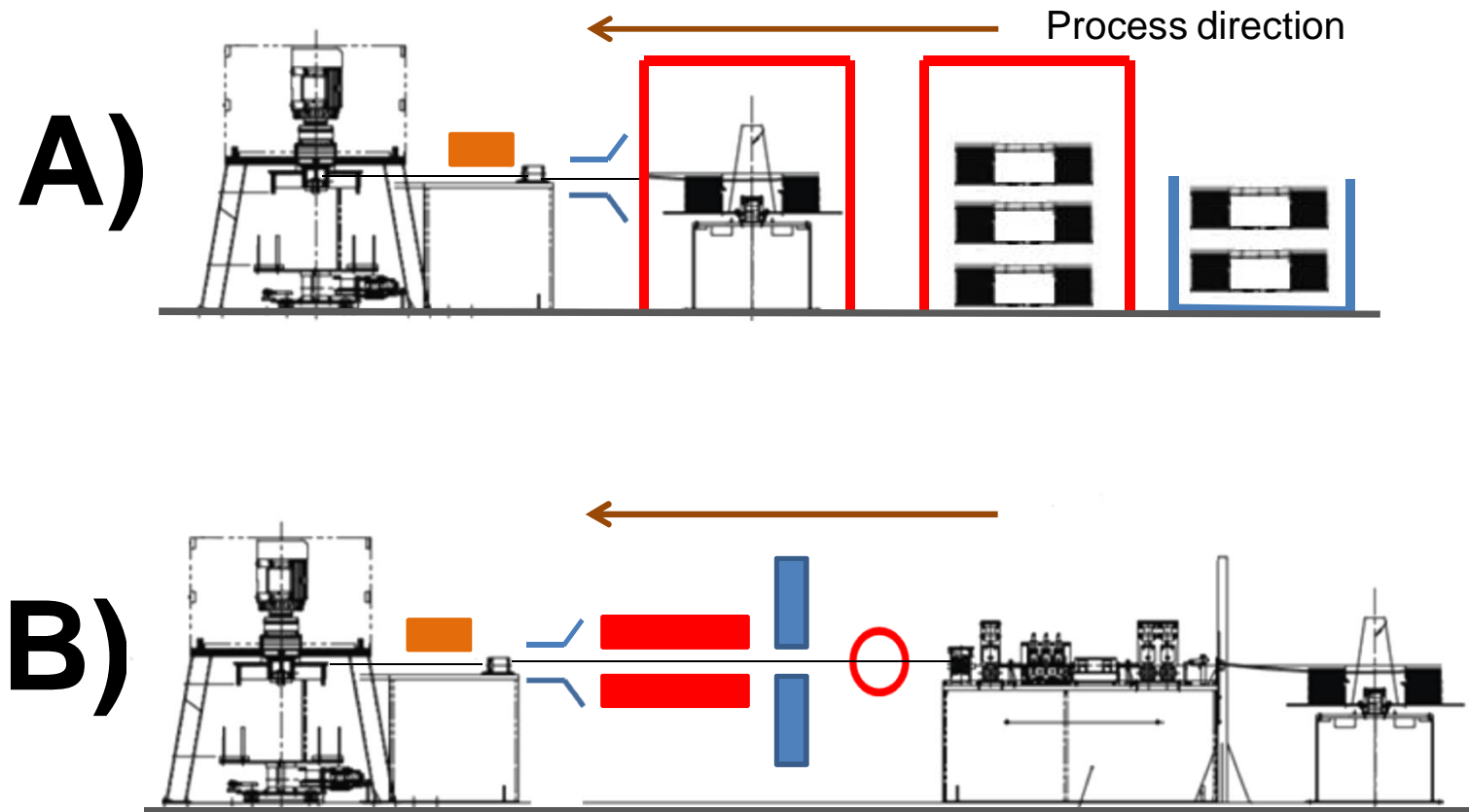
Before drawing the raw coil will be dipped into a lub bath, then the lub is dried at ambient temperature and finally the coil is heated-up in a furnace on process temperature of e.g. 100°C

B) Inline Lub Application

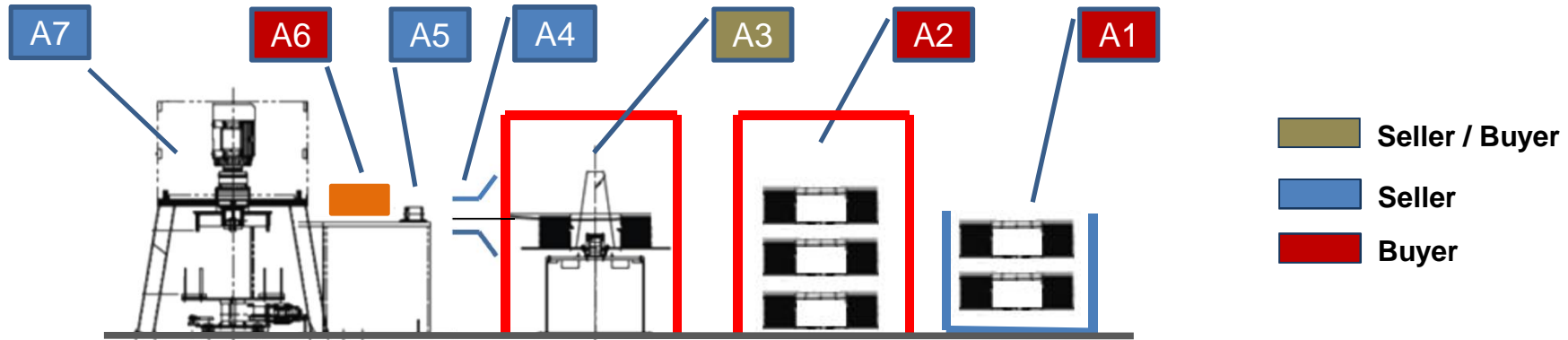
Lub application and heating-up of the wire will be done immediately before the drawing die.

In first stage the wire will be heated-up by resistance heaters up to process temperature of e.g. 100°C, then lub will be applied by spray nozzles and in the final stage be dried by induction heaters

Layout of Solution A and B



Solution A



A1 Tank for dipping the coils into the lubricant (lub shall dry at ambient temperature)

A2 Furnace for heating up the coils up to approx. 100°C (max. 200°C possible)

A3 Payoff with heat box to maintain constant temperature during uncoiling

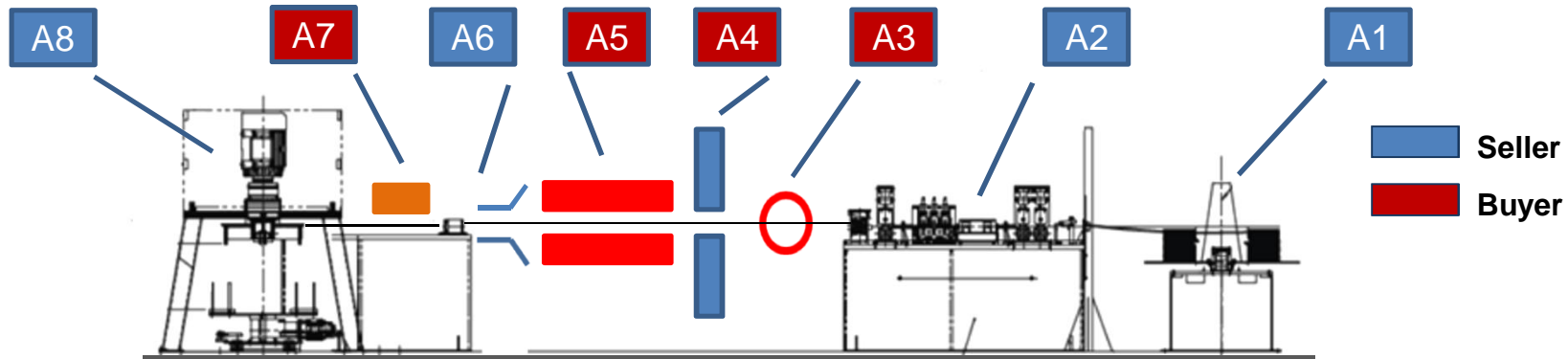
A4 Guiding to enter straight with the lead end of the wire into the drawing die

A5 Drawing die for reduction normally between 10 – 25%

A6 Lub removal system to avoid slipping on the take-up drum of the bloc at pulling

A7 Inverted bloc with drive and coil collecting unit

Solution B



A1

Payoff for uncoiling of the wire at ambient temperature

A2

Pre-straightener for entering straight into the heating / lub section

A3

Resistance heaters for heating up the wire up to approx. 100°C (max. 200°C possible)

A4

Lub application by spray nozzles

A5

Inductive heaters for drying of the lubricant before entering into the drawing die

A6

Guide funnel and drawing die for reduction normally between 10 – 25%

A7

Lub removal system to avoid slipping on the take-up drum of the bloc at pulling

A8

Inverted bloc with drive and coil collecting unit

Comparison of Solution A and B

Solution A	Solution B
Common process when the wire is first drawn and afterwards again processed by shaving (and grinding)	Common process when the wire has been shaved first and finished after drawing
Extensive and time consuming process for applying the lub, heating-up and maintaining the temperature of the coil	For optimum results temperature of heaters and type and volume of lub have to be proper adjusted acc. to the speed
Due to the slippery wire surface pre-straightener is not suitable. Manual feeding has to be supported by guiding elements	Pre-straightener are required to enable a safe transport through the inline heaters and improving also the drawing process. Guiding elements are required at feeding
Remaining lubricant behind the drawing die shall be removed (shot blasting, washing, brushing) to avoid slipping at the take-up drum during the pulling process	Remaining lubricant behind the drawing die shall be removed (shot blasting, washing, brushing) to avoid slipping at the take-up drum during the pulling process

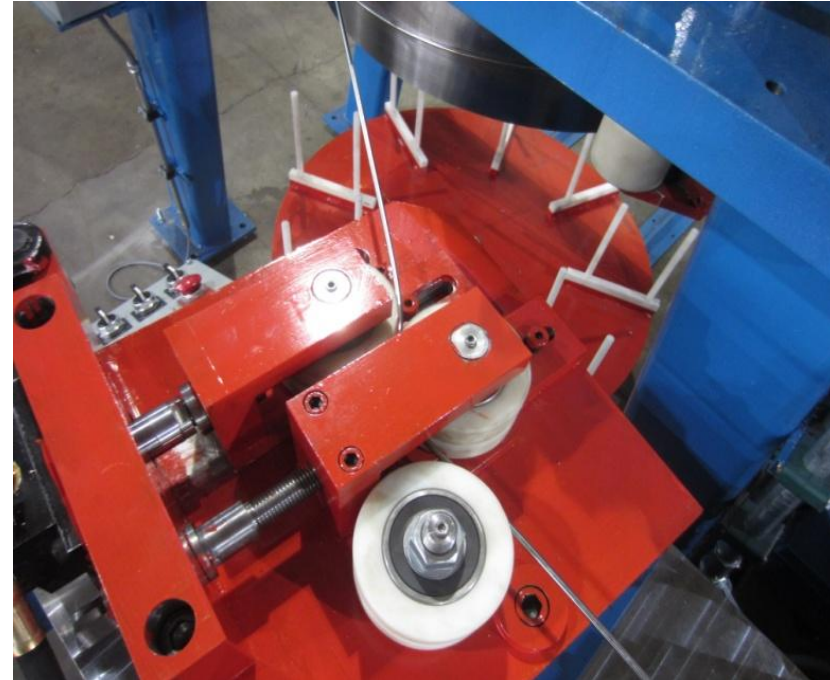
Payoff with Pre-Straightener



Die Stand and Inverter Bloc



Die stand with support for lub removal system / Inverter bloc



Tiltable casting unit and below turntable with plastic fingers

Clamping Dog



Pulling dog with chain to pick up the new coil lead



Drawn coil is being cast between the fingers of the take-up carrier