Performance Specifications
for
Model B140 Balancing Machine
50000 kg (110000 Pounds) Capacity
End Drive/Machining Type

1. GENERAL DESCRIPTION

1.1 Balancing Machine

1.1.1 The Model B140 is a dynamic, horizontal axis, soft bearing balancing machine. It uses moving coil transducers to measure the motion of an unbalanced rotor on freely moving suspensions. The machine must be firmly mounted to a standard reinforced concrete floor, but does not require any special foundation. In order to provide an easy to use transportable mounting method, track clamps are provided to lock the pedestals and console to an existing railroad track or an optional prefabricated railroad track bed assembly. The Model B140 has an End Drive console with a variable speed motor and multi-speed gearbox for efficient transfer of torque to the rotor. The End Drive system uses a cardan shaft (supplied) to spin the rotor. Adapters to attach the cardan shaft to the rotor are the customers' responsibility. The use of a cardan shaft may require the use of electronic tooling compensation (a feature in the Model 295 instrument) to eliminate errors due to fit-up and/or unbalance in the adapter tooling.

The machine and instrument are easy to set up and use. The standard calibration method uses trial weights to calibrate the rotor to the balancing instrument for the most accurate possible unbalance readout.

1.2 Instrumentation

1.2.1 The standard balancing instrument is the Model 295 which has large digital display meters and shaft synchronous digital filters. Dynamic (Left/Right), Static and Couple unbalance can be displayed, individual workpiece setups can be stored and the balance results can be printed on an external printer. The instrument also displays the angle position of the rotor to aid in placing the correction weights on the rotor. Detailed specifications on the 295 instrument are separate from these performance specifications.

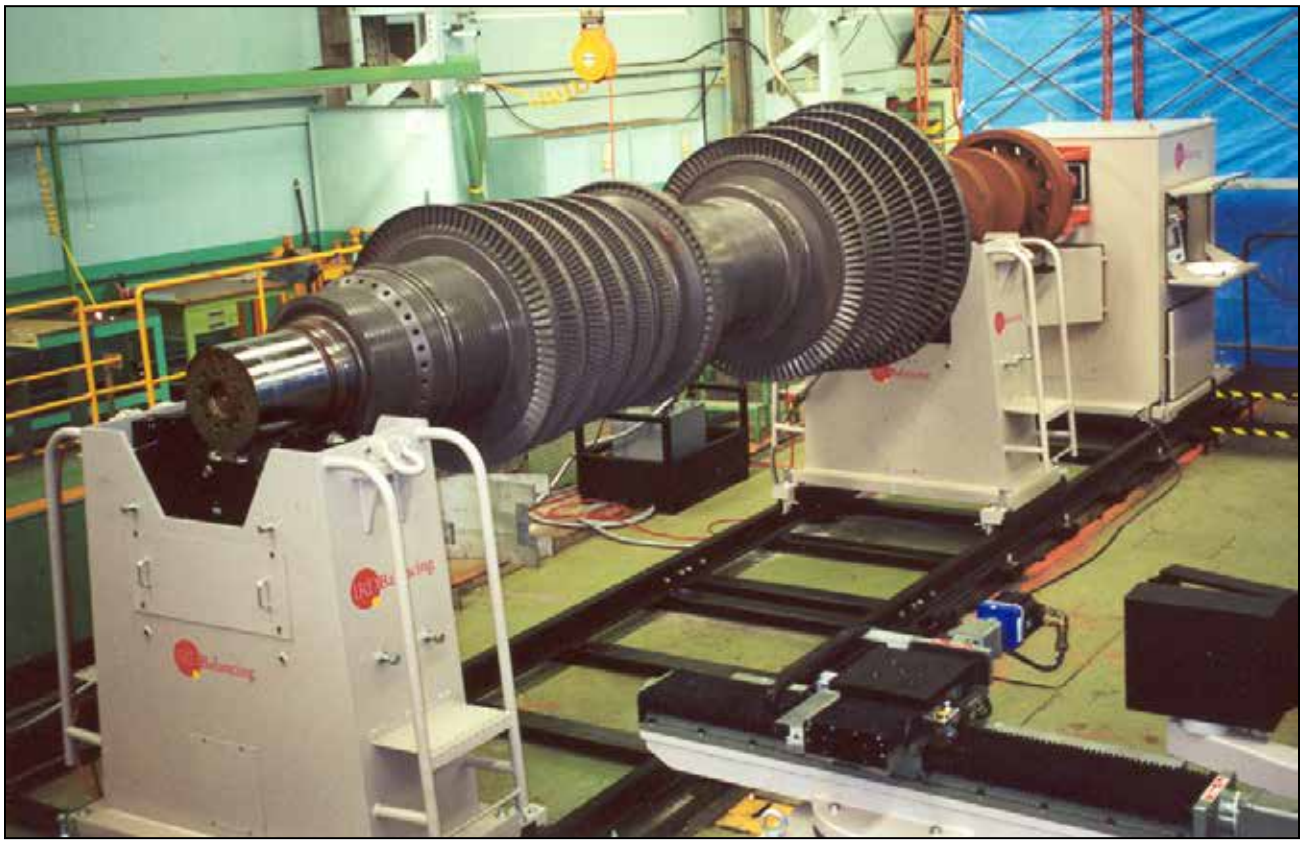

Figure 1 - B140 Balancing Machine

2. SPECIFICATIONS

2.1 Rotor Mass and Unbalance Limitations

2.1.1 Maximum weight capacity

2.1.1.1 Standard Roller Bearings (270 mm) 50000 kg (110000 pounds)

2.1.2 Maximum weight per support

2.1.2.1 Standard Roller Bearings (270 mm) 34000 kg (75000 pounds)

2.1.2.2 Capacity Note: *Total rotor weight cannot exceed the maximum capacity of paragraph 2.1.1*

2.1.3 Minimum weight

2.1.3.1 Standard Roller Bearings (270 mm) 450 kg (1000 pounds)

2.1.4 Minimum Achievable Residual Unbalance (U_{mar}) per plane under ideal rotor conditions 0.2 g mm/kg (.004 g in/lb) *but not less than 180 g mm (7 g in)*

2.1.5 Unbalance Reduction Ratio 95%

2.2 Rotor Dimensions

2.2.1 Maximum rotor diameter (with Standard Rollers) 3900 mm (154 inches)

2.2.2 Maximum distance between support bearing centerlines Limited Only by Installation Space Available

2.2.3 Minimum distance between support bearing centerlines 915 mm (36 inches)

Journal diameters accommodated on roller bearings (Sets 2 – 4 optional)

2.2.3.1 Set 1 (270 mm diameter) 300 to 800 mm (12 to 32 inches)

2.2.3.2 Set 2 (260 mm diameter) 100 to 500 mm (4 to 20 inches)
(weight capacity range 230 kg to 36300 kg per pair)

2.2.3.3 Set 3 (200 mm diameter) 60 to 710 mm (2.5 to 28 inches)
(weight capacity range 230 kg to 22700 kg per pair)

2.2.3.4 Set 4 (160 mm diameter) 180 to 300 mm (7 to 12 inches)
(weight capacity range 230 kg to 22700 kg per pair)

2.2.4 Rotor Centerline from Floor

2.2.4.1 On 60 mm Journal diameter 1532 mm (60.3 inches)

2.2.4.2 On 800 mm Journal diameter 1955 mm (77 inches)

2.2.5 Maximum Difference in Rotor Journal Diameters with Equal Diameter Rollers 229 mm (9 inches)

2.2.6 Height Adjustment Travel (total) 114 mm (4.5 inches)

2. SPECIFICATIONS (continued)

2.3 Drive System

2.3.1	Type of drive system	End Drive, DC Motor with multi-speed gearbox and adjustable length Cardan Shaft	
2.3.2	Cardan Shaft, Heavy Duty, Precision, Adjustable Length		
2.3.2.1	Type	Universal Joint	
2.3.2.2	Length	915 to 1030 mm	(36 to 40.5 inches)
2.3.2.3	Weight	66 kg	(145 pounds)
2.3.2.4	Maximum Torque	8800 N m	(6500 lb ft)
2.3.2.5	Angle from Horizontal		
2.3.2.5.1	Maximum	±12º	
2.3.2.5.2	For stated Umar	±3º	
2.3.2.6	Maximum Unbalance Error		
2.3.2.6.1	Non-Systematic (with axial adjustment – see note 1)	8625 g mm	(340 g in)
2.3.2.6.2	Systematic (see notes)	1440 g mm	(56 g in)

Note 1. Non-systematic errors are errors whose maximum value is known, but cannot be compensated by index balancing. The maximum non-systematic unbalance error includes driveshaft unbalance, eccentricity in mounting the driveshaft to the rotor and misalignment or eccentricity in the axial adjustment mechanism. The listed error is for a mounting eccentricity of 0.0127 mm (0.0005 inches) between the geometric centerline of the rotor (determined by the two journal support surfaces) and the geometric centerline of the driveshaft (determined by the machined male rabbet diameter).

Note 2. Systematic errors are repeatable errors that can be compensated by index balancing.

Note 3. Additional systematic unbalance measurement errors (due to unbalance and eccentricity) occur when adapters are used between the rotor and the driveshaft. These should be estimated and added to the driveshaft errors to determine the total error due to the attachment tooling.

2.3.3	Motor	DC Variable Speed, Drip Proof Frame and Cooling Blower, Mounted inside control console
2.3.4	Supply voltage (specify frequency on order)	
2.3.4.1	460 Mains Power	460VAC, 50 or 60 Hz 3 Phase, 91 A
2.3.5	Rated Output Power	45 kW (60 HP)
2.3.6	Recommended Drive Isolation Transformer Input Power rating	75 KVA

2. SPECIFICATIONS (continued)

2.3.7	Output Torque, Maximum		
	2.3.7.1 At motor	372 N m	(274 pound feet)
	2.3.7.2 At Cardan Shaft (Gear #9)	836 N m	(617 pound feet)
	2.3.7.3 At Cardan Shaft (Gear #5)	2842 N m	(2096 pound feet)
	2.3.7.4 At Cardan Shaft (Gear #1)	10575 N m	(7799 pound feet)
2.3.8	Acceleration Torque	Same as output torque, Section 2.3.7	
2.3.9	Braking Torque	Same as output torque, Section 2.3.7	
2.3.10	Motor speed, Maximum		
	2.3.10.1 At motor	1150 RPM	
	2.3.10.2 At Cardan Shaft (Gear #9)	511 RPM	
	2.3.10.3 At Cardan Shaft (Gear #5)	150 RPM	
	2.3.10.4 At Cardan Shaft (Gear #1)	40 RPM (slow roll, machining only)	
2.3.11	Type of brake	Regenerative with supplementary dual air actuated disk brake for rotor holding	
2.3.12	Motor and Controller	To NEMA and AMT standards	
2.3.13	Controller Speed range	20:1	
2.3.14	Balancing speed	70 to 511 RPM	
2.3.15	Slow Roll/Machining Speed	1.9 to 61	
2.3.16	Gearbox	Multi-speed, Heavy Duty Gearbox with 11 speed ranges. Gearbox is located inside control console and is shifted only under no load conditions.	

GEAR	MIN. RPM	MAX. RPM
Low Rev	1.9	39
Hi Rev	6.6	131
1	2.0	40
2	3.0	61
3	4.1	82
4	5.6	112
5	7.5	150
6	10.4	208
7	14.0	279
8	19.1	381
9	25.6	511

2.3.17	Air Supply Requirement	480 to 690 kPa at 0.85 m³/h (70 to 100 psi at 0.5 cfm)

3. MACHINE COMPONENTS

3.1 Machine Bed

3.1.1 No Machine Bed is required. The pedestals and console attach directly to any existing railroad spur, either flush with the floor or on top of the floor. If railroad track is not available, the pedestals and console can be directly lagged to the concrete floor. An optional Railroad Track Bed Assembly is available that provides the benefit of a railroad spur but with the advantage that it can transported with the machine and be placed on any concrete floor.

3.2 Work Supports

3.2.1 Two super critical (above resonance) pedestals with high output moving coil vibration transducers support the rotor to be balanced. The transducer calibration is traceable to National Institute of Standards & Technology (USA). (Transducers are furnished with Balancing Instrument).

3.2.2 Both work supports contain a manually adjustable height adjustment mechanism for leveling rotors with unequal diameter journals.

3.2.3 Each work support contains a Cradle Assembly that provides gimbal pivoting action for the precision flat rollers which in turn provide line contact with rotor journals at all times. This method reduces the risk of scoring or high concentrated loads on the rotor journals.

3.2.4 Set # 1 - Roller Assembly (Standard) - Two Full Capacity Roller Bearing assemblies with 270 diameter x 245 mm wide flat rollers (10.75 x 9.62 inch) for journal diameters of 300 to 800 mm (12 to 32 inches).

3.2.5 Pedestals are bolted to the floor or clamped to railroad track. They must be positioned as required to accommodate various rotor lengths.

3.3 End Drive Control Console

3.3.1 The control console contains the DC Drive Motor and a Regenerative DC Drive Motor Controller with circuit disconnect switch completely wired ready for operation on the specified AC supply voltage. An input cable from the customer's AC supply voltage source to the console is required. A drive isolation transformer for other voltages is optional.

3.3.2 Dual Air Actuated Calipers and Disc for Rotor Holding.

3.3.3 Multi-speed gearbox with 11 speeds.

3.3.4 An adjustable length Driveshaft is provided to connect the output shaft of the console to the rotor.

3.3.5 Operator Controls consisting of START and STOP pushbuttons, JOG/RUN switch, SPEED control knob, Brake OFF-NORM switch with air pressure regulator and gauge, semi-automatic Journal Lubrication control button and rotation selector switch for Clockwise or Counterclockwise Rotation.

3. MACHINE COMPONENTS (continued)

3.3.6 Ampere Readout 0 to 200 AMPS (0 to 200 C/s) Maximum with 3-Position PHASE Selector switch and Power ON Light

3.3.7 End Thrust Readout 0 to 8500 newtons (0 to 2000 pounds).

3.3.8 Rotor Angle Indicator on output shaft is graduated in 1º increments with a reference pointer for positioning the rotor.

3.3.9 Model 295 Balancing Instrument. (See Section 3.4)

3.3.10 Printer for printing Balance Certificates

3.3.11 Operator Writing Shelf.

3.4 **Instrumentation - See Section 1.2**

3.4.1	Instrument supplied	Model 295 Balancing Instrument (see separate specification sheet for 295)

3.5 **Accessories** (included with Balancing Machine)

3.5.1 (1) Height Adjustment Tool

3.5.2 (1) Driveshaft

3.5.3 (2) Operation manuals

3.5.4 (1) Printer

3.5.5 Lubrication fittings for roller assemblies

4. PAINT

4.1 **Standard color** –Pedestals and Console — Warm Gray - Pantone 7C 5

5. GENERAL ARRANGEMENT

5.1 **Design Details** — See Drawing D98340

5.2 **Overall Dimensions**

5.2.1	Pedestals			
	5.2.1.1	Length	1956 mm	(77 inches)
	5.2.1.2	Width	762 mm	(30 inches)
	5.2.1.3	Height	1630 mm	(64.2 inches)
5.2.2	Console			
	5.2.2.1	Length	1588 mm	(62.5 inches)
	5.2.2.2	Width	1588 mm	(62.5 inches)
	5.2.2.3	Height	2235 mm	(88 inches)
5.2.3	Parts Box			
	5.2.3.1	Length	1219 mm	(48 inches)
	5.2.3.2	Width	813 mm	(32 inches)
	5.2.3.3	Height	660 mm	(26 inches)

5. GENERAL ARRANGEMENT (continued)

5.3 Weight

5.3.1	Pedestals		
5.3.1.1	Pedestal #1	2767 kg	(6100 pounds)
5.3.1.2	Pedestal #2	2767 kg	(6100 pounds)
5.3.2	Console	3220 kg	(7100 pounds)
5.3.3	Parts Box	567 kg	(1250 pounds)
5.3.4	Net Shipping Weight (all items)	9421 kg	(20770 pounds)

5.4 Export Shipping Crate Dimensions

5.4.1	Shipping Note:	Machine may be shipped uncrated when using a container.	
5.4.2	Pedestals		
5.4.2.1	Length	2032 mm	(80 inches)
5.4.2.2	Width	914 mm	(36 inches)
5.4.2.3	Height	1778 mm	(70 inches)
5.4.3	Console		
5.4.3.1	Length	1727 mm	(68 inches)
5.4.3.2	Width	1727 mm	(68 inches)
5.4.3.3	Height	2388 mm	(94 inches)
5.4.4	Parts Box		
5.4.4.1	Length	1219 mm	(48 inches)
5.4.4.2	Width	813 mm	(32 inches)
5.4.4.3	Height	660 mm	(26 inches)

5.5 Export Shipping Weight

5.5.1	Pedestals		
5.5.1.1	Pedestal #1	2880 kg	(6350 pounds)
5.5.1.2	Pedestal #2	2880 kg	(6350 pounds)
5.5.2	Console	3697 kg	(8150 pounds)
5.5.3	Parts Box	567 kg	(1250 pounds)
5.5.4	Gross Shipping Weight (all items)	10124 kg	(22320 pounds)

6 INSTALLATION

6.1	Foundation Requirements	A normal reinforced concrete floor is recommended. No special heavy concrete substructure is required as long as the floor is capable of safety supporting the weight of the balancing machine plus its maximum weight capacity and does not permit any pedestal motion during the balancing operation.
6.2	Mounting	Pedestals, console and optional railroad track, if used, must be secured to each other and the foundation to prevent movement during balancing.

7. OPTIONAL MODIFICATIONS AND ACCESSORIES

7.1	Railroad Track Bed Assembly, length - 10000 mm (33 feet)	P/N E33203
7.2	Railroad Track Bed Assembly, length - 13400 mm (44 feet)	P/N E29353
7.3	Roller Carriage Assembly (Set 2), 230 to 36300 kg (500 to 80000 pounds) capacity per pair with 260 mm diameter x 133 mm wide (10.25 x 5.25 inches) flat rollers and journal diameter range of 100 to 500 mm (4 to 20 inches).	P/N E13415
7.4	Roller Carriage Assembly (Set 3), 230 to 22700 kg (500 to 50000 pounds) capacity per pair with 200 mm diameter x 76 mm wide (8 x 3 inches) flat rollers and journal diameter range of 60 to 710 mm (2.5 to 28 inches).	P/N E10666-800
7.5	Roller Carriage Assembly (Set 4), 230 to 22700 kg (500 to 50000 pounds) capacity per pair with 160 mm diameter x 76 mm wide (6.25 x 3 inches) flat rollers and journal diameter range of 180 to 300 mm (7 to 12 inches).	P/N E10666-625
7.6	Console and Pedestal risers for increased rotor swing diameters up to 6045 mm (238 inches). Standard Riser heights- 150, 300, 450, 610, 910, and 1060 mm (6, 12, 18, 24, 36, and 42 inches)	
7.7	Custom Paint Color.	
7.8	Spare Parts Kit. Includes two spare 270 mm (10.75 inches) diameter rollers, one set of suspension bearings for one pedestal and one operation manual.	P/N E49435
7.9	Negative Load Hold-Down Assembly rated at 26000 newtons (6000 pounds) capacity for balancing rotors with an outboard center of gravity. For use with 22700 kg (50000 pound) capacity roller work supports.	P/N E26292
7.10	Rotor Safety Hold-Down Frame with Counter Roller to constrain rotor from vertical movement during balancing.	P/N E11741

7. OPTIONAL MODIFICATIONS AND ACCESSORIES (continued)

7.11	Heavy Duty Precision U-Joint Cardan Driveshaft, Fixed Length.		P/N E34020
7.11.1	Length	965 mm	(38 inches)
7.11.2	Weight	39 kg	(85 pounds)
7.11.3	Maximum Torque	8800 N m	(6500 pound-feet)
7.11.4	Angle from Horizontal		
7.11.4.1	Maximum	±12º	
7.11.4.2	For stated Umar	±3º	
7.11.5	Maximum Unbalance Error, (see Section 2.3.2 Notes)		
7.11.5.1	Systematic	1440 g mm	(56 g in)
7.12	Medium Duty Precision U-Joint Cardan Driveshaft for medium weight rotors, Fixed Length.		P/N E43673
7.12.1	Length	965 mm	(38 inches)
7.12.2	Weight	24 kg	(52 pounds)
7.12.3	Maximum Torque	4949 N m	(3650 pound-feet)
7.12.4	Angle from Horizontal		
7.12.4.1	Maximum	±12º	
7.12.4.2	For stated Umar	±3º	
7.12.5	Maximum Unbalance Error, (see Section 2.3.2 Notes).		
7.12.5.1	Systematic	1440 g mm	(56 g in)
7.13	Light Duty Precision U-Joint Cardan Driveshaft for lightweight rotors, Fixed Length.		P/N E35474
7.13.1	Length	940 mm	(37 inches)
7.13.2	Weight	20 kg	(45 pounds)
7.13.3	Maximum Torque	3254 N m	(2400 pound-feet)
7.13.4	Angle from Horizontal		
7.13.4.1	Maximum	±12º	
7.13.4.2	For stated Umar	±3º	
7.13.5	Maximum Unbalance Error, (see Section 2.3.2 Notes).		
7.13.5.1	Systematic	1440 g mm	(56 g in)

7.14 Transformer for voltages other than standard AC supply voltage. The transformer is mounted on a transportable frame with an integral flexible cable that can be wired into the disconnect switch on the control console. The cable between the transformer and the AC source is the customer's responsibility.

7. OPTIONAL MODIFICATIONS AND ACCESSORIES (continued)

7.15 A Drive Isolation Transformer. This is recommend to protect the drive controller from AC line transients caused by other high current draw equipment or by AC power disruptions. This is not required if the transformer from Section 7.14 is used. The transformer is mounted on a transportable frame with an integral flexible cable that can be wired into the disconnect switch on the control console. The cable between the transformer and the AC source is the customer's responsibility.

7.16 Other D.C. drive motors are available:

7.16.1 56kW (75 HP), 460VAC, 50 or 60 Hz, 3 Phase, 116A.
(A 93 KVA drive isolation transformer is recommended for use with this motor)

7.16.2 75kW (100HP), 460VAC, 50 or 60 Hz, 3 Phase, 149A.
(A 118 KVA drive isolation transformer is recommended for use with this motor)

8. SAFETY NOTE:

Safety guards or enclosures are required to meet relevant safety regulations. It is the buyer's responsibility to insure that the Balancing Machine has an adequate safety protection system before operating the machine.

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IRD P/N 51348 Rev 14 10 Apr 2012

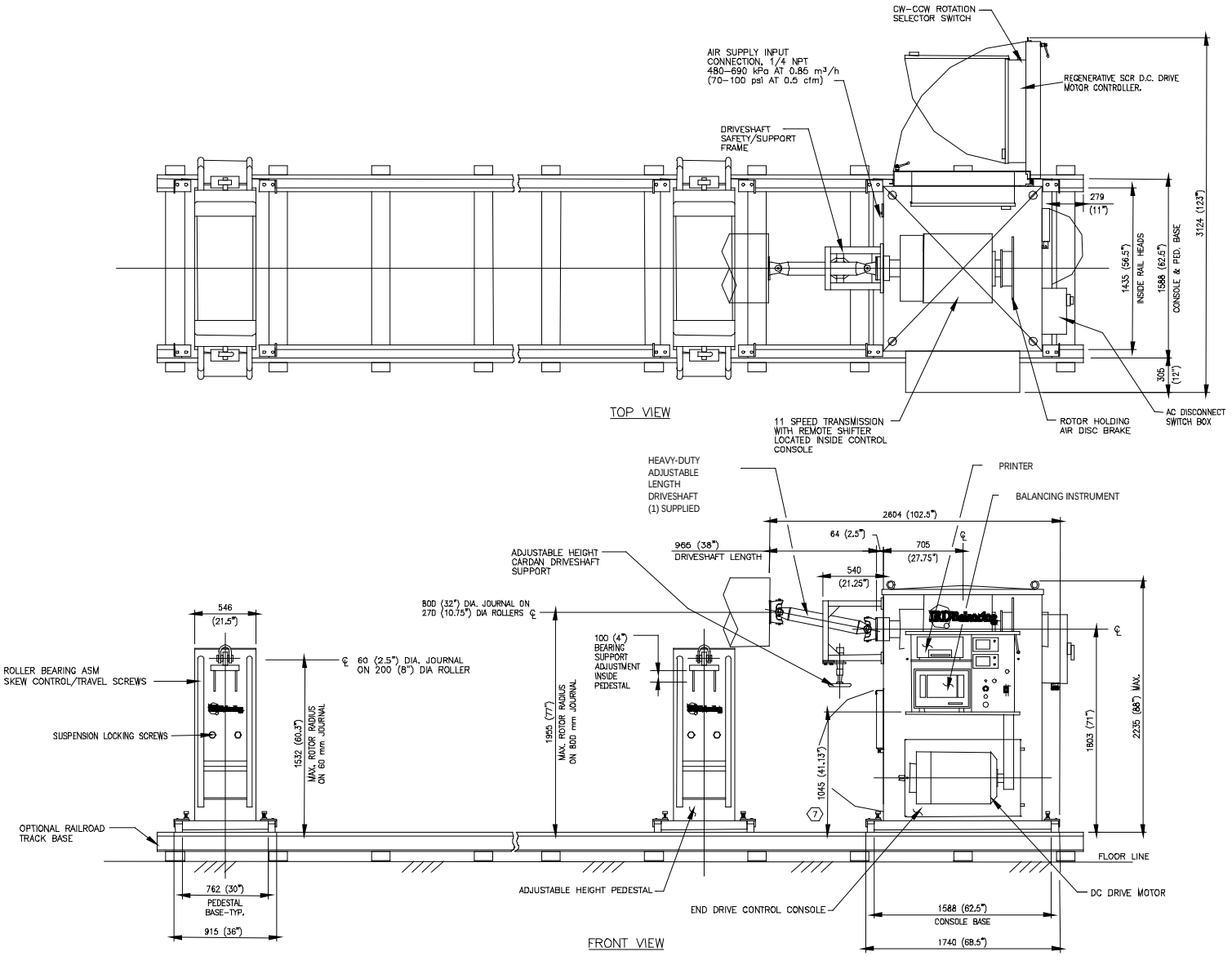

Figure 2 - B140 Machine Layout with Optional Railroad Track Base