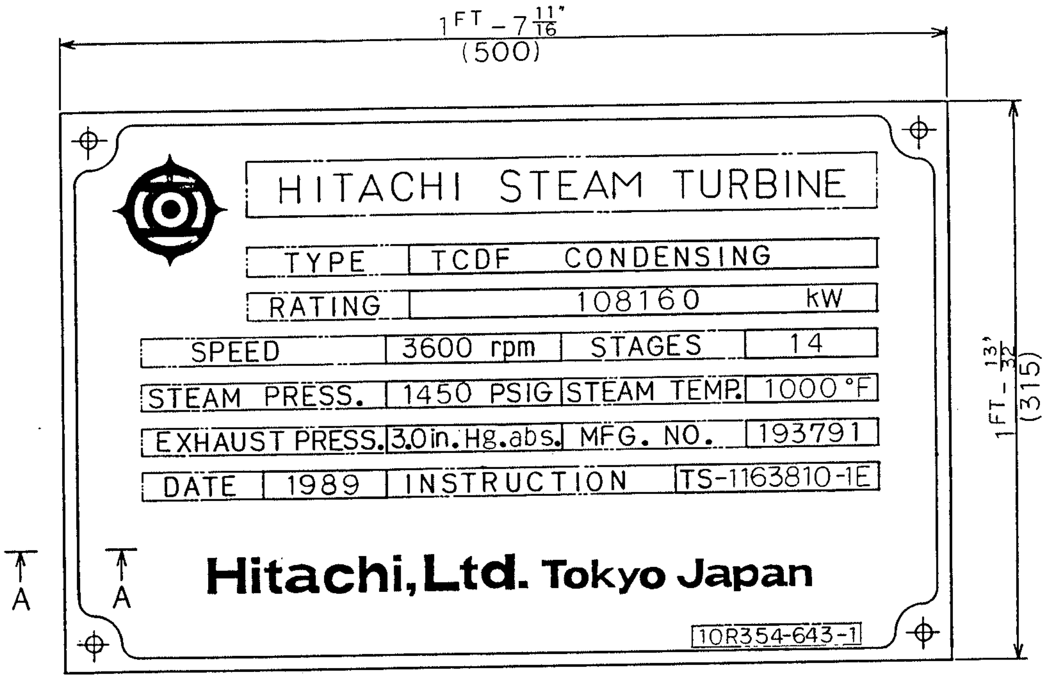
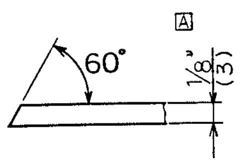
SYM.	DWG. ZONE	REVISIONS	DATE	REVD.	CHKD.	RE DWG	MTR	RE MF.
A	C-1	ADDED DIMENSION 1/8".	88.09.30	N. Suzuki	Y. Kikuchi			



NOTE

1. THE OUTER FRAME AND FIGURES WILL BE COLORED IN BLACK.
2. MATERIAL — STAINLESS STEEL (CODE: JIS SUS304-HP)
3. 10R354-643-1 IN THIS DRAWING IS WORKING DRAWING No..



SECTION A A (SCALE 2/1)

FINAL DRAWING

Hitachi, Ltd.
88-10-06
HITACHI WORKS

ACE COGENERATION COMPANY

ARGUS COGENERATION EXPANSION PROJECT

DWN.	N. Suzuki	88.07.11	THIRD ANG. PROJ.	TITLE: NAME PLATE OF STEAM TURBINE
CHKD.	N. Suzuki	88.07.11		
	Y. Kikuchi	88.07.12	SCALE 1/2	
APPD.	K. Kashiwabara	88.07.12		

Hitachi, Ltd. Tokyo Japan

HITACHI WORKS DWG. NO. 10R354-642 REV'D. A

S A H Q

S 221350 (A2 DWG. PAPER)

GENERAL DESCRIPTION

GENERAL :

This turbine is a multi-stage, extraction and condensing steam turbine with the rating given in the TURBINE DESIGN DATA filed on Item 1 of Tab. 2.

The turbine incorporates design and construction features which have proved their reliability and efficiency in a large number of units of a comparable type.

TURBINE CASING :

The turbine casing is made up of a high pressure casing and exhaust casing bolted together at a vertical joint, and is split at the turbine horizontal centerline to provide access to the rotor and internal parts. The casing is machined to receive the interstage diaphragms.

The cast-steel high pressure casing, with its integral steam chest, is particularly adapted for high pressure and high temperature operation. The casing halves are symmetrical, relatively uniform in thickness and have circumferential extraction passageways. This construction minimizes distortion and misalignment.

The high pressure casing is bolted to the front-bearing standard, and supported on center line. This arrangement allows the casing to expand and contract in all directions without disturbing the center-line alignment. The front-end standard moves forward when the turbine expands.

TURBINE ROTOR :

The rotor body is made from a solid alloy-steel forging for single casing units.

Prior to machining, various tests are made to assure that the forgings meet the required physical and metallurgical properties. Rotor body is machined carefully to form a solid rotor composed of shaft, wheels, bearing journals and coupling flange. The formed wheels are machined to receive the dovetails of the buckets.

MOVING BLADES :

The moving blades are made from a chrome-iron alloy that is extremely resistant to corrosion and erosion by steam. They are machined from bar stock and are dovetailed to the wheel rims by a tight machine fit. Metal shrouding strips are used to fasten together the outer ends of the moving blades. These segment-punched strips are fitted over the moving blade tenons, and hand-riveted in place.

On last-stage moving blades, where the tip speed is high, stellite shields are attached to the upper portion of each last-stage moving blade as an additional safeguard against erosion, due to moisture.

NOZZLES AND DIAPHRAGMS:

The nozzle partitions make the steam flow to the following moving blades with the proper angle and velocity. The nozzle areas and angles of discharge are determined by many variables, including volume of steam to be passed, speed of the adjacent moving blade and steam pressure ahead of the diaphragm.

Nozzle partitions are machined from a solid chrome-iron alloy and, are incorporated into the diaphragm by welding process.

The pre-machined chrome-iron alloy partitions are assembled in punched-steel strips, and tack-welded in position. This assembly in then welded to the diaphragm web and to the outer ring.

BEARINGS:

The main bearings are self aligning, spherical seated, and pressure lubricated. The bearing casing are made from cast steel or steel plate and are lined with high-grade, tin-base babbitt. Seals are provided to prevent the oil or vapour in the bearings from creeping along the rotor.

The axial position of the rotor is maintained by a thrust bearing that is located on the rotor in front of the turbine-front bearing. The thrust bearing is simple in construction, occupies little space, and has a high load carrying capacity.

PACKINGS:

Steam leakage or air infiltration, which may occur through the clearance between the rotating and the stationary elements of the turbine, is minimized by gland packings.

All shaft gland packings are of the metallic labyrinth type. Spring-backed, segmented packing rings are fastened in the bore of the high-pressure casing. These rings are machined with alternate high and low teeth that are fitted with minimum clearance into matching grooves, cut directly into the turbine rotor. The small clearance and the resistance offered by this series of high and low-tooth construction restricts steam flow to a minimum. Intermediate and atmospheric leak-offs are provided and sealing steam is supplied to the leak-off space between the labyrinth packings.

Steam leakage, along the rotor at the bores of the diaphragms, is held to a minimum by metal packing rings, fitted in the diaphragms. The rings are divided into segments with each segment supported by a flat spring. The springs hold the segments in place and maintain a small clearance between the packing rings and the rotors.

The segmented, spring-backed ring will provide additional clearance if the rotor should become distorted as a result of some transient operating condition. Segments of the ring will spring back at each revolution and prevent serious damage to the ring or heavy rubbing of the rotor. This reduces the possibility of local heating, which might damage the shaft.

TURNING GEAR DEVICE :

The turning gear is used to turn the rotor at approx. 2 rpm when starting, in order to evenly heat or cool the rotor and reduce the possibility of distortion. It is also used to turn the rotor small amounts during inspection periods.

The turning gear consists of an electric-motor and a train of gears. The gear train is driven by the motor, through a silent chain. A movable pinion in the gear casing can be engaged with the ring gear on the coupling flange of the turbine rotor.

When steam is admitted to the turbine during operation of the turning gear, the movable pinion will, by means of a clutch gear, immediately and permenently disengage without shock. An indicator with a signal switch is provided to show whether or not the turning gear is in operation.

A pressure switch is provided to prevent operation of the turning gear without a supply of oil to the turbine-generator bearings.

TURBINE DESIGN DATA

Hitachi manufacturing No. --------------	K193791
Hitachi Turbine No. --------------------	T-415
Technical Specifications :	
Type ------------------------------	SC-26 (Hitachi impulse type, tandem compound single extraction, single flow exhaust condensing turbine, indoor use)
Normal rating --------------------	108,160 kW (at no process)
Speed ------------------------------	3,600 rpm
Direction of rotation ------------	Counter-clockwise when viewed from turbine front
Rated inlet steam pressure -------	1,450 psig (101.9 kg/cm^2.g)
Rated inlet steam temperature -----	1,000°F (538°C)
Rated extraction steam pressure at turbine flange ---------	460 psig (32.3 kg/cm^2.g)
Exhaust steam pressure ------------	3.0 in. Hg abs. (76.2 mm Hg abs.)
Number of stages -------------------	14 (H.P. : 3, I.P. : 7, L.P. : 4)
Number of extraction ;	
Uncontrolled --------------------	Four (6th, 8th, 10th and 12th stage shell)
Controlled -------------------	One (1) (3rd stage shell)
Length of last stage bucket -----	26 in. (663.6 mm)
Type of rotor ----------------------	Solid-forged
Method of coupling -----------------	Rigid (bolts-coupled)

Technical Specifications (Cont'd) :

Journal bearings ;

Type	Elliptical over-shot with spherical-seat self-aligning type
Number	2
Size (D x L)	#1 9 in. × 7 in. (228.6 mm x 178 mm) #2 14 in. × 8 in. (355.6 mm x 203 mm)

Thrust bearing ;

Type	Tapered-land (located in turbine front standard)
Effective area	175.8 sq.in. (1,134.4 cm^2)
Bearing gap	14 - 16 mils (0.36 - 0.40 mm)

Type of governor	Hitachi digital type electro-hydraulic governor
Control function of governor	Speed/load and extraction steam pressure

Main stop valve ;

Type	Non-positioning hydraulic-operated globe valve
Number	One (1)
Nominal diameter	12 in. (305 mm)

H.P. control valve ;

Type	Positioning hydraulic-operated globe valve
Number	4
Nominal diameter	$4\frac{59}{64}$ in. and $3\frac{31}{32}$ in. (125 and 100 mm)

Extraction control valve ;

Type	Positioning hydraulic-operated globe valve
Number	4
Nominal diameter	$7\frac{3}{32}$ in. (180 mm)

Technical Specifications (Cont'd) :

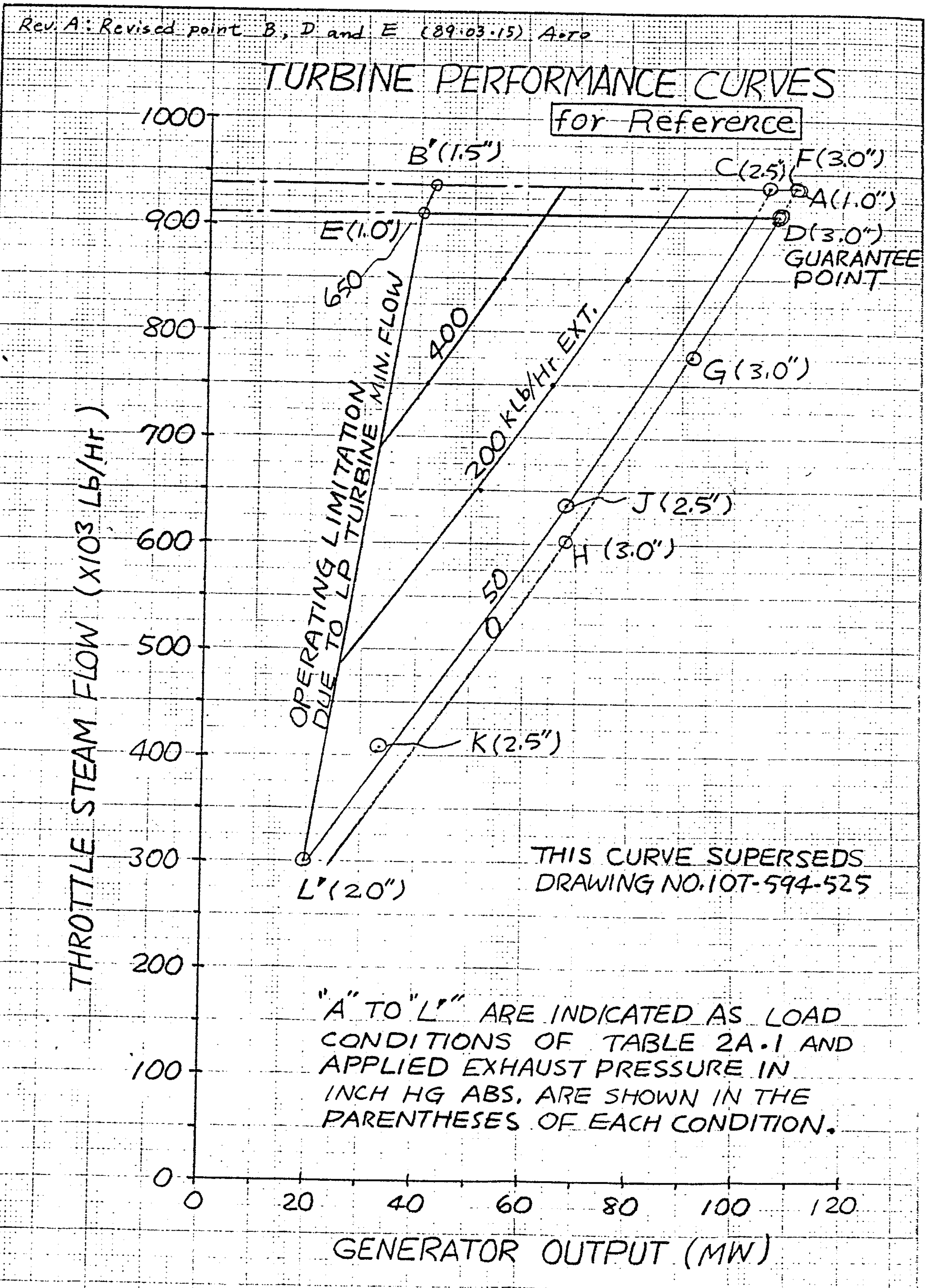
Critical speeds of turbine-generator combined rotor;

	Critical speeds (rpm)	Mode
First	1,624	Generator rotor (1st)
Second	2,049	Turbine rotor (1st)
Third	4,266	Generator rotor (2nd)

Frequency range of safely continuous operation ------------- 58.5 - 60.5 Hz

Definition of shaft-vibration amplitude level on normal operation (peak to peak : mils)

Very good ------------------	Less than 1.5
Normal ---------------------	Less than 2.0
Acceptable ------------------	Less than 3.5
Rebalance or acceptable until corrective action can be taken ----------------------	Less than 5.0
Tolerance for short time ---	Less than 6.0
Immediately stop ------------	7.5 or over 6.0 in case of rapid increase



88.07.12
88.07.15
88.07.18

TURBINE PERFORMANCE CURVES

10T-605-527 A

10S542-681

NO.	REVISIONS	DATE	REVD.	CHKD.
A	REVISED LOAD CONDITIONS B, D, E, K AND L	88·12·14	[illegible]	[illegible]

PERFORMANCE SUMMARY TABLE

LOAD CONDITION	NET TURBINE CAPABILITY AT	THROTTLE STEAM CONDITION (psia/°F)	THROTTLE STEAM FLOW (lb/h)	EXHAUST PRESSURE (in.Hg abs)	BOILER BLOWDOWN (%)	PROCESS STEAM FLOW (lb/h)	SJAE STEAM FLOW (lb/h)	NH_3 INJECTION STEAM FLOW (lb/h)	GENERATOR OUTPUT (KW)	GROSS HEAT RATE (Btu/kWH)	HEAT BALANCE DRAWING No.
A	MAX. CALCULATED (V.W.O.)	1450/1000	937300	1.0	0.0	0	0	0	111530	8936	10S542-682
B	MAX. EXTRACTION (V.W.O.)	1450/1000	937300	1.5	1.0	650000	500	650	42740	23492	A 10S542-683
C	EXPECTED OPERATION (V.W.O.)	1450/1000	937300	2.5	1.0	50000	500	650	106750	9354	10S542-684
D	GUARANTEED UNIT CAPABILITY	1450/1000	910000*	3.0	1.0	0	500	650	108130*	8966*	B 10S496-898
E	GUARANTEED EXTRACTION CAPABILITY	1450/1000	910000*	1.0	1.0	650000*	500	650	40210	24243	A 10S542-685
F	FIRST VALVE POINT	1450/1000	937300	3.0	1.0	0	500	650	111410	8963	10S542-686
G	SECOND VALVE POINT	1450/1000	776000	3.0	1.0	0	500	650	91690	9017	10S542-687
H	THIRD VALVE POINT	1450/1000	602000	3.0	1.0	0	500	650	67970	9436	10S542-688
J	EXPECTED 70% OPERATING	1450/1000	637000	2.5	1.0	50000	500	650	68000	9980	10S542-689
K	EXPECTED 45% OPERATING	1450/950	409500	2.5	1.0	50000	500	650	33460	12671	A 10S542-690
L	EXPECTED 33% OPERATING	1450/925	300000	2.0	1.0	50000	500	650	19820	15441	A 10S542-691

* : GUARANTEED VALUES

DWN.	Y. TAKEDA	88·08·20	TITLE PERFORMANCE SUMMARY TABLE
CHKD.	S. HOIZUMI	88·08·20	Hitachi, Ltd. Tokyo Japan
APPD.	Y. HORIKAWA	88·08·20	HITACHI WORKS DWG. NO. 10S542-681 A