Contents

Project: Model: Chk'd: Date:

Material Comparison Table

MATERIALS	JIS CODE	ASTM, AISI CODE
Cast Iron	G5501, FC20	ASTM A-48 Class 30
420 Stainless	G4303, SUS429J1	AISI 420
304 Stainless Steel	G4303, SUS304	AISI 304
Steel	G3101, SS41	ASTM A283 Grade D
Brass	H3201, BSP3	ASTM B36 No. 272

Project: Model: Chk'd: Date:

Impeller Data

MODEL	TYPE	DESIGN	# VANES	BACK P.O. VANES
50DLU6.75	semi-open	radial	single	yes
50DLU61.5	semi-open	radial	single	yes
80DLU61.5	semi-open	radial	single	yes
80DLMU61.5	semi-open	radial	single	yes
80DLU62.2	semi-open	radial	2	yes
80DLMU62.2	semi-open	radial	single	yes
80DLU63.7	semi-open	radial	2	yes
80DLMU63.7	semi-open	radial	2	yes
100DLU61.5	semi-open	radial	2	no
100DLU62.2	semi-open	radial	2	no
100DLU63.7	semi-open	radial	2	no
50DVU6.75	semi-open	radial-recessed	8	yes
50DVU61.5	semi-open	radial-recessed	8	yes
50DVU62.2	semi-open	radial-recessed	8	yes
80DVU61.5	semi-open	radial-recessed	8	yes
80DVCU62.2	semi-open	radial-recessed	8	yes
80DVBU62.2	semi-open	radial-recessed	8	yes
80DVBU63.7	semi-open	radial-recessed	8	yes
80DVCU63.7	semi-open	radial-recessed	8	yes
100DVU63.7	semi-open	radial-recessed	8	yes
32DGUII61.5	semi-open	radial-recessed	10	yes
32DGFU61.5	semi-open	radial-recessed	10	yes
50DGFU62.2	semi-open	radial-recessed	10	yes
50DGFU63.7	semi-open	radial-recessed	10	yes
50DLFU61.5	semi-open	radial	single	yes
80DLFU61.5	semi-open	radial	single	yes
80DLMFU61.5	semi-open	radial	single	yes
80DLFU62.2	semi-open	radial	2	yes
80DLFMU62.2	semi-open	radial	single	yes
80DLFU63.7	semi-open	radial	2	yes
80DLMFU63.7	semi-open	radial	2	yes
80DLFU65.5	semi-open	mixed flow	2	yes
80DLMFU65.5	semi-open	mixed flow	2	yes
80DLFU67.5	semi-open	mixed flow	2	yes
80DLCMFU 67.5	semi-open	mixed flow	2	yes
80DLF611	semi-open	mixed flow	2	yes
80DLCMFU611	semi-open	mixed flow	2	yes

Project: Model: Chk'd: Date:

Impeller Data

MODEL	TYPE	DESIGN	# VANES	BACK P.O. VANES
80DLFU615	semi-open	mixed flow	2	yes
80DLFU618	semi-open	mixed flow	2	yes
80DLFU622	semi-open	mixed flow	2	yes
100DLFU61.5	semi-open	radial	2	no
100DLFU62.2	semi-open	radial	2	no
100DLFU63.7	semi-open	radial	2	no
100DLFU65.5	semi-open	mixed flow	2	yes
100DLMFU65.5	semi-open	radial	2	no
100DLFU67.5	semi-open	mixed flow	2	yes
100DLFU611	semi-open	mixed flow	2	yes
100DLFU615	semi-open	mixed flow	2	yes
100DLFU618	semi-open	mixed flow	2	yes
100DLFU622	semi-open	mixed flow	2	yes
100DLFU630	enclosed	radial	2	yes
100DLFU637	enclosed	radial	2	yes
100DLFU645	enclosed	radial	2	yes
150DLFU67.5	semi-open	mixed flow	2	yes
150DLFU611	semi-open	mixed flow	2	yes
150DLFU615	semi-open	mixed flow	2	yes
150DLFU618	semi-open	mixed flow	2	yes
150DLFU622	semi-open	mixed flow	2	yes
150DLFU630	enclosed	mixed flow	2	yes
150DLFU637	enclosed	mixed flow	2	yes
150DLFU645	enclosed	mixed flow	2	yes
200DLFU67.5	semi-open	mixed flow	2	yes
200DLFU611	semi-open	mixed flow	2	yes
200DLFU615	semi-open	mixed flow	2	yes
200DLFU618	semi-open	mixed flow	2	yes
200DLFU622	semi-open	mixed flow	2	yes
200DLFU630	enclosed	mixed flow	2	yes
200DLFU637	enclosed	mixed flow	2	yes
200DLFU645	enclosed	mixed flow	2	yes
250DLFU611	semi-open	mixed flow	2	yes
250DLFU615	semi-open	mixed flow	2	yes
250DLFU618	semi-open	mixed flow	2	yes
250DLFU622	semi-open	mixed flow	2	yes
250DLFU630	enclosed	mixed flow	2	yes
250DLFU637	enclosed	mixed flow	2	yes
250DLFU645	enclosed	mixed flow	2	yes
300DLFU618	semi-open	mixed flow	2	yes
300DLFU622	semi-open	mixed flow	2	yes

Project: Model: Chk'd: Date:

Impeller Data

MODEL	TYPE	DESIGN	# VANES	BACK P.O. VANES
300DLFU630	enclosed	mixed flow	2	yes
300DLFU637	enclosed	mixed flow	2	yes
300DLFU645	enclosed	mixed flow	2	yes
50DVF61.5	semi-open	radial-recessed	8	yes
50DVF62.2	semi-open	radial-recessed	8	yes
80DVF61.5	semi-open	radial-recessed	8	yes
80DVBF62.2	semi-open	radial-recessed	8	yes
80DVCF62.2	semi-open	radial-recessed	8	yes
80DVBF63.7	semi-open	radial-recessed	8	yes
80DVCF63.7	semi-open	radial-recessed	8	yes
80DVF65.5	semi-open	radial-recessed	8	yes
80DVF67.5	semi-open	radial-recessed	8	yes
80DVBF611	semi-open	radial-recessed	8	yes
80DVCF611	semi-open	radial-recessed	8	yes
80DVCF615	semi-open	radial-recessed	8	yes
80DVCF618	semi-open	radial-recessed	8	yes
80DVCF622	semi-open	radial-recessed	8	yes
100DVF63.7	semi-open	radial-recessed	8	yes
100DVF65.5	semi-open	radial-recessed	8	yes
100DVF67.5	semi-open	radial-recessed	8	yes
100DVBF611	semi-open	radial-recessed	8	yes
100DVCF611	semi-open	radial-recessed	8	yes
100DVDF611	semi-open	radial-recessed	8	yes
100DVCF615	semi-open	radial-recessed	8	yes
100DVDF615	semi-open	radial-recessed	8	yes
100DVDF618	semi-open	radial-recessed	8	yes
100DVDF622	semi-open	radial-recessed	8	yes
150DVBF611	semi-open	radial-recessed	8	yes
150DVBF615	semi-open	radial-recessed	8	yes
150DVBF618	semi-open	radial-recessed	8	yes
150DVCF618	semi-open	radial-recessed	8	yes
150DVBF622	semi-open	radial-recessed	8	yes
150DVCF622	semi-open	radial-recessed	8	yes
100×80DDLFU611	semi-open	mixed flow	2	yes
100×80DDLFU615	semi-open	mixed flow	2	yes
100×80DDLFU618	semi-open	mixed flow	2	yes
100×80DDLFU622	semi-open	mixed flow	2	yes
150×100DDLFU611	semi-open	mixed flow	2	yes

Project: Model: Chk'd: Date:

Impeller Data

MODEL	TYPE	DESIGN	# VANES	BACK P.O. VANES
150×100DDLFU615	semi-open	mixed flow	2	yes
150×100DDLFU618	semi-open	mixed flow	2	yes
150×100DDLFU622	semi-open	mixed flow	2	yes
150×100DDLFU630	enclosed	radial	2	yes
150×100DDLFU637	enclosed	radial	2	yes
150×100DDLFU645	enclosed	radial	2	yes
200×150DDLFU611	semi-open	mixed flow	2	yes
200×150DDLFU615	semi-open	mixed flow	2	yes
200×150DDLFU618	semi-open	mixed flow	2	yes
200×150DDLFU622	semi-open	mixed flow	2	yes
200×150DDLFU630	enclosed	mixed flow	2	yes
200×150DDLFU637	enclosed	mixed flow	2	yes
200×150DDLFU645	enclosed	mixed flow	2	yes
200×150DDLFU630	enclosed	mixed flow	2	yes
200×150DDLFU637	enclosed	mixed flow	2	yes
200×150DDLFU645	enclosed	mixed flow	2	yes
200×200DDLFU630	enclosed	mixed flow	2	yes
200×200DDLFU637	enclosed	mixed flow	2	yes
200×200DDLFU645	enclosed	mixed flow	2	yes
250×250DDLFU630	enclosed	mixed flow	2	yes
250×250DDLFU637	enclosed	mixed flow	2	yes
250×250DDLFU645	enclosed	mixed flow	2	yes
300×300DDLFU630	enclosed	mixed flow	2	yes
300×300DDLFU637	enclosed	mixed flow	2	yes
300×300DDLFU645	enclosed	mixed flow	2	yes

Motor Protection (Auto-Cut)

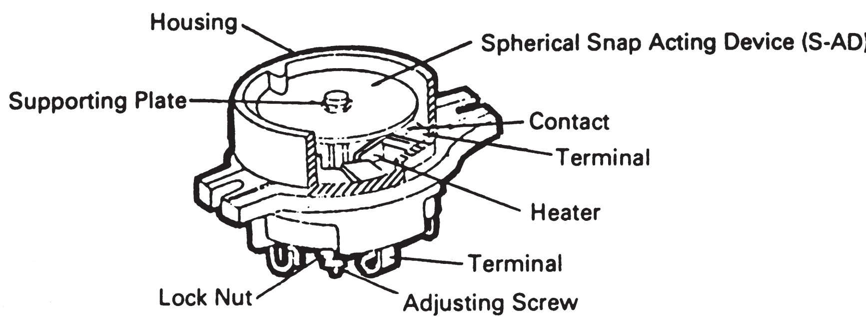
1. MODELS DLU, DVU, DGUII

2. CONSTRUCTION AND PRINCIPLES OF OPERATION

There are two different types of Auto-Cuts. One is a single pole model that is used for single phase motors and the other is a three pole model that is used for three phase motors. Figure 1 below illustrates the construction and operation of the three phase model.

Composition: 3 sets of contacts, 1 Snap-Acting Disk, 3 Heaters, 3 Terminals and 1 Calibration bolt and nut. The above parts are encased in a Bakalite housing.

FIGURE 1



The Auto-Cut is installed directly over the winding of the motor, where it not only senses overheating of the winding but also excess amperage draw by each of the three windings.

Figure 2 shows the Auto-Cut in its normal operating condition (Contacts closed). When actuating temperature is reached, the Snap-Acting Disk snaps open to interrupt the circuits as shown in figure 3.
When the motor temperature cools down to the safe operating temperature, the Snap-Acting Disk resets automatically to the original position as shown in figure 2, and the motor restarts.

FIGURE 2

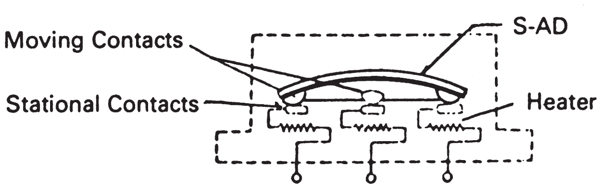
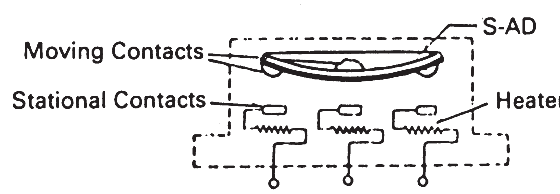


FIGURE 3



3. PROVIDES PROTECTION FROM THE FOLLOWING:

Single Phasing
Low Voltage
Phase Imbalance
Locked Rotor
Run Dry

All of the above conditions will cause the motor protector to actuate.

Project: Model: Chk'd: Date:

Thermal Protection

The motor shall be equipped with a protector such as automatic cut-off device and thermal protector. The motors described below shall incorporate Miniature Thermal Protectors (MTP) which are embedded in the windings.

When temperature of the winding raises and reaches the MTP acting point, the motor protection circuit is activated to protect motor from over heat.

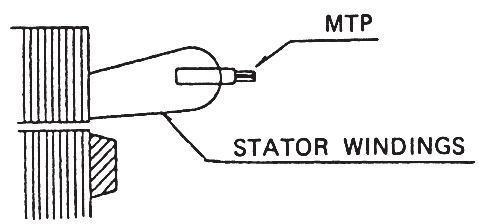
1. **Applicable model**
   Model: DGFU, DLFU, DVFU, DDLFU

2. **MTP Specifications:**

Model	KLIXON 9700K-66-215
Type of Contact	b (Normally-Closed contact Acting-open)
Acting Temperature	140±5°C (284±9°F)
Re-setting Temperature	85±10°C (185±18°F)
Capacity of Contact	

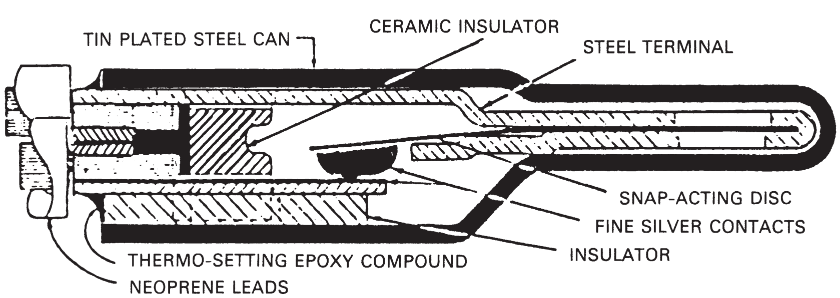
Voltage (V)	DC 24	AC 115	AC 230	AC 460
Amperage (A)	18	18	13	5.5

3. **Installation:**
   MTP shall be embedded in the stator windings as shown at right—



4. Construction:

Construction of the MTP is as shown below:



Project: Model: Chk'd: Date:

Details of Leakage Detector

1. Applicable model

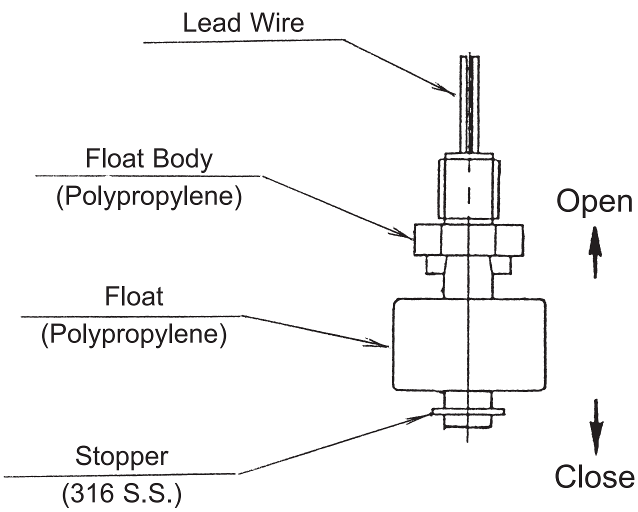
Model: DGFU, DLFU, DVFU, DDLFU

2. Construction:

Each switch has a magnet-containing float which senses the liquid level and magnetically actuates a dry reed switch encapsulated within a stem. The switch opens on rise of liquid.

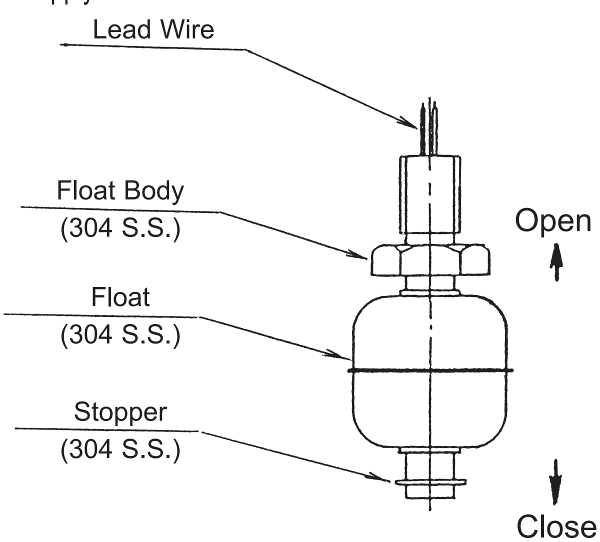
3. Specifications

- Apply to 2 to 30HP



Breaking Capacity : AC50VA, DC50W
Max. Breaking Current : AC0.5A, DC0.5A
Max. Operating Voltage : AC300V, DC300V

- Apply to 40 to 60HP



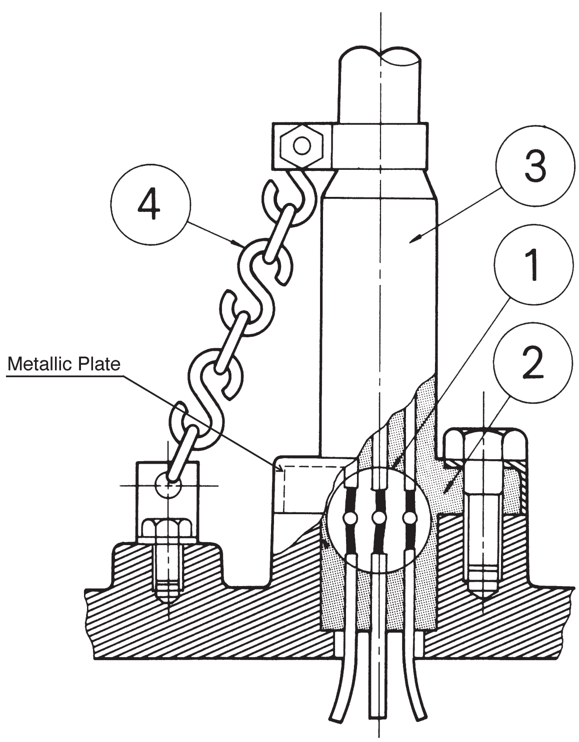
Breaking Capacity : AC12VA, DC10W
Max. Breaking Current : AC0.6A, DC0.5A
Max. Operating Voltage : AC200V, DC200V

Project: Model: Chk'd: Date:

Details of Cable Entry (1 of 2)

Applicable to Models DGUII, DLU, DVU

1	Water cannot leak into motor even if the cable is cut or damaged because cable leads are soldered and then isolated by rubber sealing, thus preventing any capillary action past that point.
2	Thick moulded shoulders bolted to motor dome provide exceptional strength and form a strong compression seal.
3	Cable resists bending forces by increased cable diameter.
4	A Strain Relief Chain or Strain Relief Gland protects cable entry from pulling.



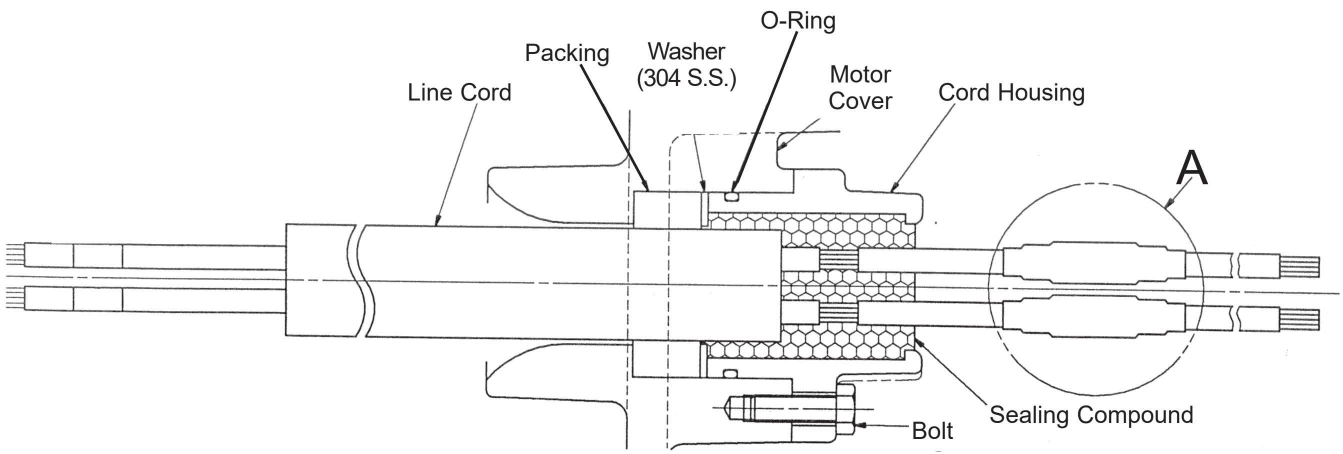
$^1/_2$ to 5HP

Project: Model: Chk'd: Date:

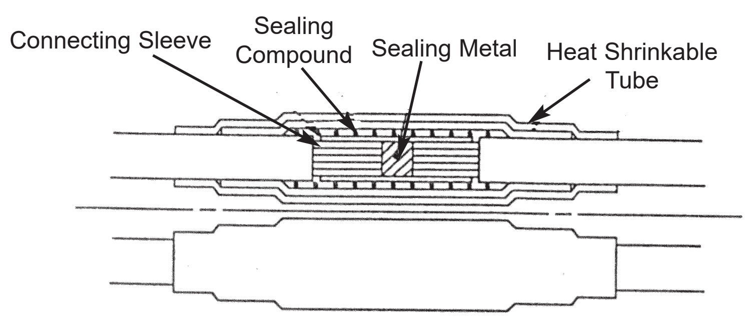
Details of Cable Entry (2 of 2)

Applicable to Models DLFU, DVFU, DDLFU, DGFU

Based on their first years of experience, EBARA now provides the most dependable cable entry construction of any submersible pump. Its features are as follows:



DETAIL "A"



Project: Model: Chk'd: Date:

Shop Painting Standards

1. **Scope**
   This specification covers the methods for painting the following EBARA PUMPS in the shop.
   EBARA Models: **DGUII, DLU, DVU, DGFU, DLFU, DVFU, DDLFU**

2. **Surface Preparation**
   All surfaces to be painted shall be cleaned of oil, grease or other similar materials with solvent, and then shall be brushed and air blasted to remove rust or scale.

   Prior to above preparation, mill scale, rust scale, chips and other foreign materials shall be removed in accordance with painting schedule.

3. **Coating Procedure**
   Detailed coating procedures are as shown in each paint schedule.

Service	Painting Schedule			
External Surface	Surface Preparation		SPPC-VISI-SP-3-63	
	Coats	Type of Paint	Brand Name	Maker
	1st	Zinc-chromate primer	ZT-PRIMER	TAIYO PAINT CO., LTD.
	2nd	Coal Tar Epoxy	Hi-Build Tneme-Tar 46-413	TNEMEC CO., INC.

Final color: Black

Service	Painting Schedule			
Internal Surface	Surface Preparation		SPPC-VISI-SP-3-63	
	Coats	Type of Paint	Brand Name	Maker
	1st	Zinc-chromate primer	ZT-PRIMER	TAIYO PAINT CO., LTD.

Project: Model: Chk'd: Date:

Mechanical Seal and Ball Bearing Data

MODEL	OUTPUT		MECHANICAL SEAL	LUBRICATING OIL			BALL BEARING	
	HP	kW	TYPE	CAPACITY		NAME	BOTTOM	TOP
				OZS	CC			
DGUII DGFU	2	1.5	A-20	41	1000	TURBINE OIL SAE 10W or 20W (TURBINE OIL #32)	6306ZZDR	6304ZZ
	3	2.2	A-30	43	1200		6308ZZDR	6304ZZ
	5	3.7	A-30	43	1200		6308ZZDR	6304ZZ

MODEL	OUTPUT		MECHANICAL SEAL	LUBRICATING OIL			BALL BEARING	
	HP	kW	TYPE	CAPACITY		NAME	BOTTOM	TOP
				OZS	CC			
DLU DLMU DVU DLFU DLMFU DVFU DDLFU	1	0.75	A-20	30	630	TURBINE OIL SAE 10W or 20W (TURBINE OIL #32)	6205ZZ	6203ZZ
	2	1.5	A-25	40	930		6306ZZ	6204ZZ
	3	2.2	A-30	50	1380		6307ZZ	6205ZZ
	5	3.7	A-30	50	1380		6308ZZ	6205ZZ
	7 1/2	5.5	A-40	90	2500		6309ZZ	6306ZZ
	10	7.5	A-40	90	2500		6309ZZ	6306ZZ
	15	11	A-40	120	3500		6313ZZ	6308ZZ
	20	15	A-45	210	6200		6315ZZ	6308ZZ
	25	18.5	A-45	210	6200		6315ZZ	6309ZZ
	30	22	A-45	210	6200		6315ZZ	6309ZZ
	40	30	A-45	220	6500		5314ZZDR	6309ZZ
	50	37	A-50	240	7000		5315ZZDR	6310ZZ
	†50	37	A-60	240	7000		5315ZZDR	6310ZZ
	60	45	A-50	240	7000		5315ZZDR	6310ZZ
	†60	45	A-60	240	7000		5315ZZDR	6310ZZ

† Apply to 100DLFU and 150×100DDLFU only

Project: Model: Chk'd: Date:

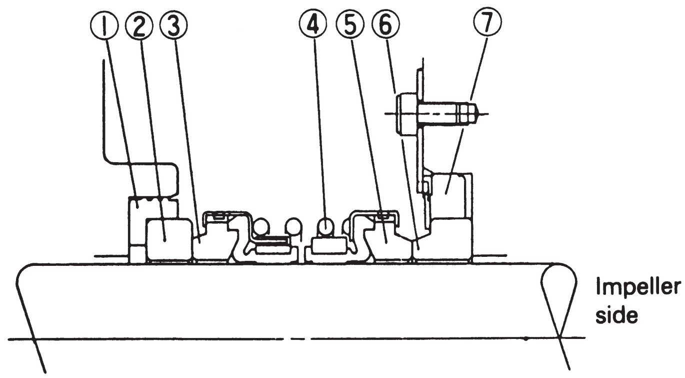
Mechanical Seal Sectional View

DOUBLE MECHANICAL SEALS with HARD seal face materials are provided on all EBARA "D Series" submersible pumps.

The double mechanical seal in oil chamber provides long life and friction-free sealing of the motor shaft.

Typical construction and materials are as follows:

- **TYPE A-20, A-25, A-30**
  DGUII, 2HP
  DGFU, 2 to 5HP
  DLU, 1 to 5HP
  DVU, 1 to 5HP
  DLFU, 2 to 5HP
  DVFU, 2 to 5HP



NO.	PART NAME	PART NAME	NO. FOR 1 SET
1	Packing	N.B.R.	1
2	Floating	Ceramic	1
3	Seal Ring	Carbon Graphite	1
4	Spring	304 SS	1
5	Seal Ring	Silicon Carbide	1
6	Floating Ring	Silicon Carbide	1
7	Packing	N.B.R.	1

Project: Model: Chk'd: Date:

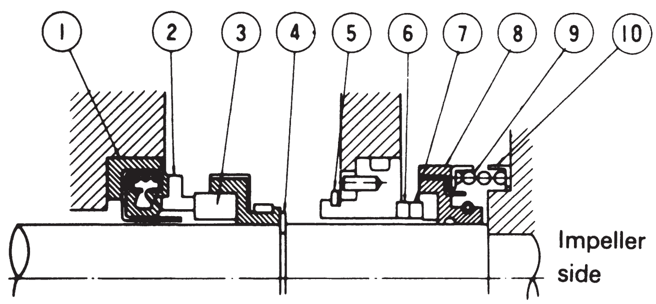
Mechanical Seal Sectional View

DOUBLE MECHANICAL SEALS in a tandem arrangement with HARD seal face materials are provided on all EBARA "D-Series" submersible pumps.

The double mechanical seal in oil chamber provides long life and friction-free sealing of the motor shaft.

Typical construction and materials are as follows:

- **TYPE A-40, A-45**
  DLFU, 7½ to 40HP
  DVFU, 7½ to 30HP
  DDLFU, 15 to 40HP



NO.	PART NAME	MATERIALS	NO. FOR 1 SET
1	Packing	N.B.R.	1
2	Seal Ring	Carbon Graphite	1
3	Floating Ring	Ceramic	1
4	Snap Ring	Spring Steel	1
5	Snap Ring	Spring Steel	1
6	Floating Ring	Silicon Carbide	1
7	Seal Ring	Silicon Carbide	1
8	Shock Absorbing Rubber	Fluorine Rubber	1
9	Spring	304SS	1
10	Spring Retainer	304SS	1

Project: Model: Chk'd: Date:

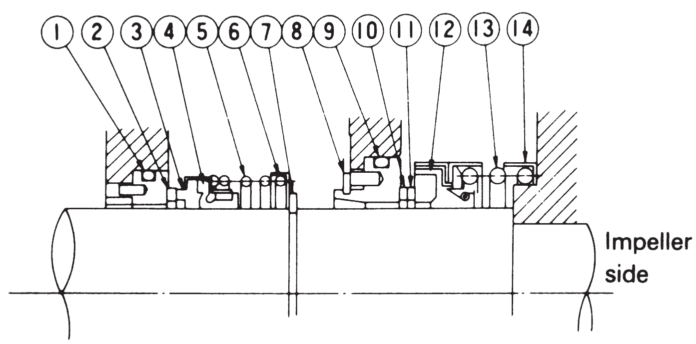
Mechanical Seal Sectional View

DOUBLE MECHANICAL SEALS in a tandem arrangement with HARD seal face materials are provided on all EBARA "D-Series" submersible pumps.

The double mechanical seal in oil chamber provides long life and friction-free sealing of the motor shaft.

Typical construction and materials are as follows:

- **TYPE A-50**
  DLFU, 50 to 60HP
  DDLFU, 50 to 60HP
  Except 100DLFU & 150×100DDLFU



NO.	PART NAME	MATERIALS	NO. FOR 1 SET
1	O-Ring	N.B.R.	1
2	Floating Ring	304SS/Ceramic	1
3	Seal Ring	Carbon Graphite	1
4	Bellows	N.B.R.	1
5	Spring	304SS	1
6	Spring Retainer	304SS	1
7	Snap Ring	Spring Steel	1
8	Snap Ring	Spring Steel	1
9	O-Ring	N.B.R.	1
10	Floating Ring	Tungsten Carbide	1
11	Seal Ring	Tungsten Carbide	1
12	Shock Absorbing Rubber	Fluorine Rubber	1
13	Spring	304SS	1
14	Spring Retainer	304SS	1

Project: Model: Chk'd: Date:

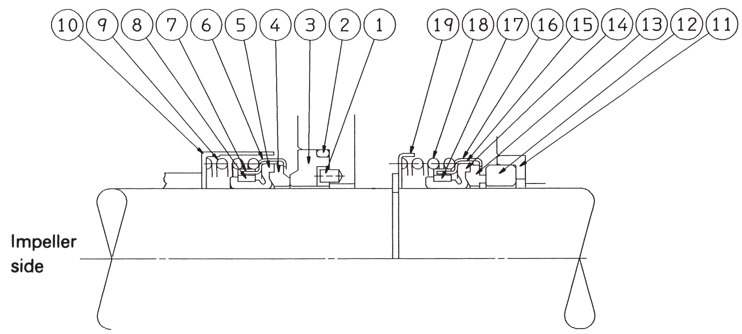
Mechanical Seal Sectional View

DOUBLE MECHANICAL SEALS in a tandem arrangement with HARD seal face materials are provided on all EBARA "D-Series" submersible pumps.

The double mechanical seal in oil chamber provides long life and friction-free sealing of the motor shaft.

Typical construction and materials are as follows:

- **TYPE A-60**
  DLFU, 50 to 60HP
  DDLFU, 50 to 60HP
  100DLFU & 150×100DDLFU ONLY



NO.	PART NAME	MATERIALS	NO. FOR 1 SET
1	Parallel Pin	316S.S.	1
2	O-Ring	N.B.R.	1
3	Stationary Ring	Silicon Carbide	1
4	Rotating Ring	Silicon Carbide	1
5	Bellows	N.B.R.	1
6	Case	304SS	1
7	Case	304SS	1
8	Drive Ring	304SS	1
9	Spring	304SS	1
10	Spring Retainer	304SS	1
11	Packing	N.B.R.	1
12	Rotating Ring	Carbon Graphite	1
13	Stationary Ring	Ceramic	1
14	Bellows	N.B.R.	1
15	Case	304SS	1
16	Case	304SS	1
17	Drive Ring	304SS	1
18	Spring	304SS	1
19	Spring Retainer	304SS	1

Project: Model: Chk'd: Date:

Maximum Submergence of Pumps

EBARA submersible pumps shall be capable of continuous submergence under water without loss of watertight integrity to the following depths:

- 65 ft.

Project: Model: Chk'd: Date:

Start and Operating Capacitor Specification

Model DGUII

Model	Start Capacitor			Operating Capacitor		
	Capacity	Voltage	Temp.	Capacity	Voltage	Temp.
32DGUII61.5S	161~193μF	250VAC	–4~+159°F	25μF	440VAC	–13~+156°F

Model DGFU

Model	Start Capacitor			Operating Capacitor		
	Capacity	Voltage	Temp.	Capacity	Voltage	Temp.
32DGFU61.5S	161~193μF	250VAC	–4~+159°F	25μF	440VAC	–13~+156°F
50DGFU62.2S	270~324μF	250VAC	–4~+159°F	35μF	440VAC	–13~+156°F
50DGFU63.7S	216~259μF	250VAC	–4~+159°F	55μF	440VAC	–13~+156°F

Model DLU/DLMU

Model	Start Capacitor			Operating Capacitor		
	Capacity	Voltage	Temp.	Capacity	Voltage	Temp.
50DLU67.5S	40μF	250VAC	–4~+159°F	20μF	440VAC	–13~+156°F
50 80DLU61.5S 100	100μF	250VAC	–4~+159°F	30μF	440VAC	–13~+156°F
80 100DLU62.2S	200μF	250VAC	–4~+159°F	35μF	440VAC	–13~+156°F
80 100DLU63.7S	400μF	250VAC	–4~+159°F	40μF	440VAC	–13~+156°F
80DLMU61.5S	100μF	250VAC	–4~+159°F	30μF	440VAC	–13~+156°F
80DLMU62.2S	200μF	250VAC	–4~+159°F	35μF	440VAC	–13~+156°F
80DLMU63.7S	400μF	250VAC	–4~+159°F	40μF	440VAC	–13~+156°F

Model DVU

Model	Start Capacitor			Operating Capacitor		
	Capacity	Voltage	Temp.	Capacity	Voltage	Temp.
50DVU6.75S	40μF	250VAC	–4~+159°F	20μF	440VAC	–13~+156°F
50 80DVU61.5S	100μF	250VAC	–4~+159°F	30μF	440VAC	–13~+156°F
50DVU 80DVCU62.2S 80DVBU	200μF	250VAC	–4~+159°F	35μF	440VAC	–13~+156°F
80DVCU 80DVBU63.7S 100DVU	400μF	250VAC	–4~+159°F	40μF	440VAC	–13~+156°F

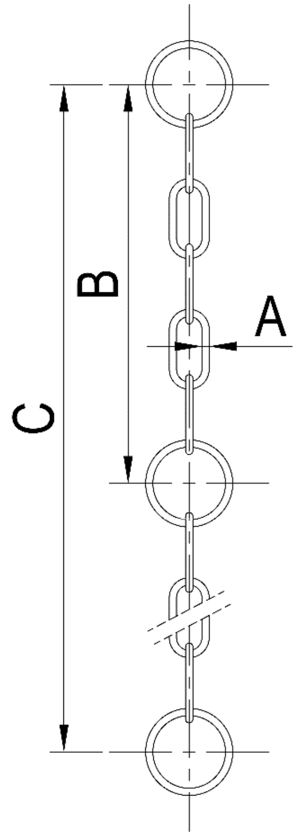
Lifting chain

Project: Model: Chk'd: Date:

Lifting Chain

The Ebara lifting chain is high tensile strength galvanized steel or stainless

Model	Size(A)		Material	Max. Load		Weight		B		Length (C)	
	Inch	mm		lbs	kg	lbs	kg	ft	m	ft	m
LCMG-6	1/4	6	Galvanized Steel	1200	544	12	5.44	2	0.61	20	6.1
LCMS-6	1/4	6	Stainless Steel	1200	544	12	5.44	2	0.61	20	6.1
LCMG-9	3/8	9	Galvanized Steel	2400	1089	24	10.89	3	0.91	20	6.1
LCLS-9	3/8	9	Stainless Steel	2400	1089	24	10.89	3	0.91	20	6.1



Application of QDC's Lifting Chain

QDC Model	Lifting Chain Model	
	Galanized Steel	Stainless Steel
LM50	LCMG-6	LCMS-6
LM65		
LM80		
LL65	LCMG-9	LCLS-9
LL80		
LL100		
LL125		
LL150		
LL250U		
LL300U		
LL150YU		
LL200YU		
LL250YU		
LL300YU		
LME50	LCMG-6	LCMS-6
LME65		
LME80		
LLE65	LCMG-9	LCLS-9
LLE80		
LLE100		
LLE125		
LLE150		
LLE250U		
LLE300U		

Standard Lengths = 20ft (6m)

To Attach Chain:

1. Unbolt Pump bail
2. Slide open end ring over bail
3. Re-bolt bail to pump top.

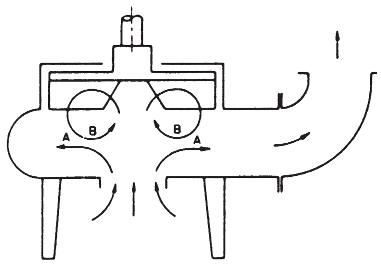
For chain lengths longer than 20 ft.:
Use "quick links" or shackles to join 20 ft. lengths.

Project: Model: Chk'd: Date:

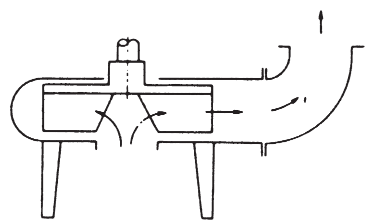
Vortex Pumps – Model DVU, DVFU

1. PRINCIPLES OF VORTEX PUMP

When the vortex impeller rotates in the casing, it generates primary vortex (B) and secondary vortex (A) as shown in the drawing, and then pumps up water:



Vortex Pump



ORDINARY NON-CLOG PUMP

2. FEATURES

a) As there is a large space between the impeller and the suction cover and there are no obstacles in the water passage, almost all sewage can be discharged without clogging.

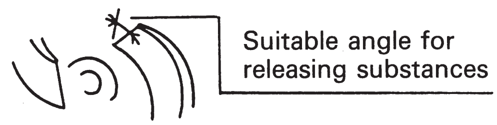
b) EBARA's unique hydraulic design of impeller and casing provide highly efficient performance which compares favorably with ordinary non-clog pump in spite of the large space.

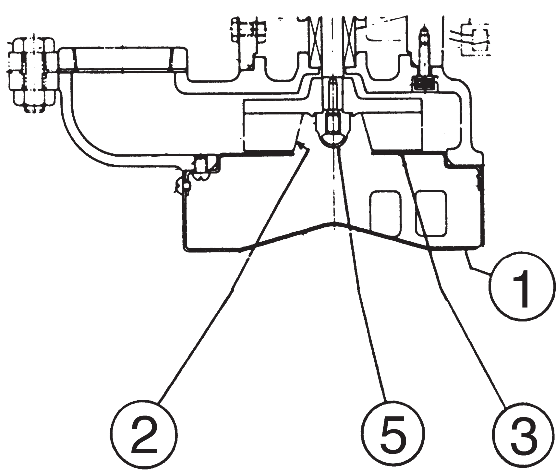
Project: Model: Chk'd: Date:

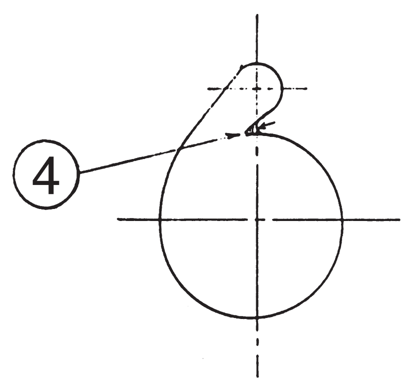
Clogging Phenomena and Prevention

From abundant experience, EBARA placed the following design concepts on sump and sewage pumps in order to prevent clogging.

CLOGGING PHENOMENA AT:	PREVENTION
1. Strainer Inlet	Choose a pump with a large strainer opening or pump without strainer.
2. Impeller Inlet	Shape inlet portion of the impeller blade as described below. The inlet edge of the impeller vanes are angled toward the impeller periphery so as to facilitate the release of objects that might otherwise clog the pump.
3. Clearance between Impeller and Suction Cover	Increase clearance – Model DVU, DVFU.
4. Casing Tongue	Provide large radius on tongue, or cut water.
5. Shaft End	Eliminate sharp points on impeller and impeller nut (use rounded impeller nut).







Project: Model: Chk'd: Date:

Three phase motors can be damaged by sustained application of unbalanced voltages. This problem can easily be more severe than application of balanced voltages above or below normal data plate ratings.

UNBALANCED PHASES

Unbalanced voltages applied to a 3 phase motor will adversely affect the motor operating characteristics. Motors will operate successfully where the variation in the supply voltage does not exceed plus or minus 10% of the name plate rating, but the voltages of a given 3 phase circuit should be evenly balanced as closely as can be read on the usually available commercial voltmeter. A relatively small unbalance in voltage will cause a considerable increase in temperature rise. For example, a 3.5% voltage unbalance will cause approximately 25% increase in temperature rise. The full load speed is reduced slightly when the motor operates on unbalanced voltages.

An unbalanced voltage will cause unequal currents to flow in the windings. If the motor is moderately or heavily loaded, currents in certain coils will exceed rating and overheat. Thermal cut-outs buried in the windings may detect this overheating and shut down the motor. If not, winding failure will result due to insulation damage.

A second type of damage is caused by rotor heating. This can occur without excessive coil current on a lightly loaded motor. Damaging currents at these frequencies will flow as a result of voltage unbalance. Rotors are not designed for such currents, especially those of recent design optimized by computer techniques. Rotor overheating is most likely to cause bearing or seal failure, again perhaps, after a long period of time. Thermal cut-outs in the stator seldom will detect this problem and starter failures have been charged to mechanical failure while the cause was actually voltage unbalance.

UNBALANCED CURRENTS

Questions relative to how much unbalance a motor can tolerate have been raised from time to time. This condition is generally due to voltage unbalance in the supply and can usually be corrected by working with the power company involved.

The effect of unbalanced phase currents is to increase the heating of the motor, thus reducing its efficiency. It might be said that unbalanced currents, as far as motor temperature rise is concerned, acts like additional load on the motor. For this reason the permissible loading decreases with increasing unbalance of phase currents.

Before a problem of this nature can be corrected, it is necessary to determine whether the source is with the **submersible motor** or with the **electrical supply furnished for its operation**. The following facts will assist in locating the source of the problem and will govern the steps to be taken in its correction.

Unbalanced amperage is generally caused by problems in either of the following areas:

A. External power supply, including the pump control box.

B. Internal problem with motor windings or stator leads to drop cable connection.

The following diagrams and explanation will present you with a method by which you can localize the problem as being caused by "A" or by "B". In other words, we are trying to find out whether the trouble lies in the area from the control back through the supply or whether it is a result of malfunction beyond the control down to and including the pump motor.

Understanding Unbalance (2 of 5)

Assuming that the unit is connected to the supply so that the 3 phase motor is running in the **correct direction of rotation**, there are two other combinations of connection that will change phase connections but not change the rotation. This is accomplished by changing the position of **all three** drop cable leads at their termination in the control. It is important that all three leads be interchanged each time as the interchanging of only two leads will result in reversing the motor.

If any two pump cable power leads are interchanged in the control it will change the rotation of the motor.

If all three leads are interchanged in the control, the pump will continue to operate in the original rotation.

Once the three power leads in the pump cable are connected to the terminals in the control so that the pump is operating in the correct direction of rotation, there are two other possible combinations that will also operate the pump in the correct direction.

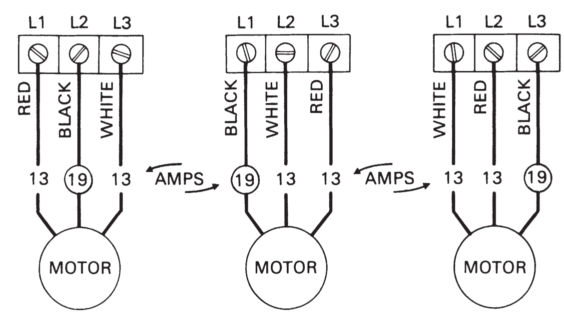
• EXAMPLE

Assuming that combination #1 is operating in correct rotation the 2nd and 3rd combination will also operate in the correct rotation.

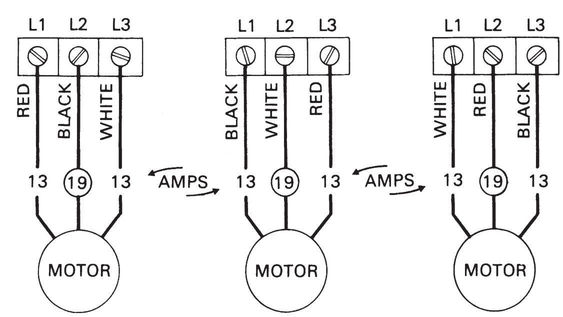
If combination #1 shows unbalanced amperage readings, it is sometimes possible that one of the other two combinations above will operate at a lesser degree of unbalance.

Combination	T1	T2	T3
1st →	Red	Black	White
2nd →	Black	White	Red
3rd →	White	Red	Black

If the unbalanced leg follows the same wire in the drop cable from the pump, regardless of which position it is connected to on the control terminals the fault would most likely be found in the stator windings or in the stator leads to drop cable connections.



If the unbalanced leg remains related to the same terminal in the control box regardless of which wire is connected to it, the fault would most likely be found in the power supply or possibly poor connection in the control.



Project: Model: Chk'd: Date:

Understanding Unbalance (3 of 5)

GENERAL CAUSES OF UNBALANCE

1. Extreme case as in Single Phasing of a 3 phase supply. The source may be in the control. Either a blown fuse, defective or poor contact point in contactor or any interruption in wiring or terminals.

2. Pulling single phase loads from the 3 phase supply in an unbalanced sequence. This can be especially true in a job shop where electrical load is unpredictable at any given time.

As we are speaking of Voltage and Amperage in terms of percentage of Unbalance, the question arises as to how to figure the % of unbalance in a three phase system. The formula reads as follows:

$$\frac{\text{Maximum Deviation from average}}{\text{Average of the 3 readings}} \times 100 = \text{Percentage of Unbalance}$$

• EXAMPLE

L1—L2 = 234V	Average of the 3 readings: 229V
L1—L3 = 230V	Maximum deviation from the average: 229–223=6V
L2—L3 = 223V	Voltage unbalance : 6/229 x 100 = 2.62%
L1 = 63.3 amps	Average of the 3 readings: 61.1 amps
L2 = 65.6 amps	Maximum deviation from the average: 61.1—54.4=6.7 amps
L3 = 54.4 amps	Amperage unbalance: 6.7/61.1 x 100 = 10.97%

Maximum permissible % of amperage unbalance allowed at motor full load is 5%. Permissible % of unbalance increases as motor load decreases. However, unless under specific conditions, the motor should, for safety, be considered to be operating at full load.

Maximum permissible % of Voltage unbalance allowed is 1%. Keep in mind that, especially with Delta wound motors, the true amperage unbalance is in the neighborhood of 6 to 10 times the voltage unbalance. The true amperage unbalance is not readily determined by the amperage readings taken in the supply lines. Excess circulating currents within the stator not recorded on your amp meter contribute to overheating of winding insulation.

The “maximum” percentages mentioned above are based on motors working at full load. Slightly higher maximums may be allowed at less than full load conditions but “good practice” and full warranty must necessarily be based on full load conditions especially with squirrel cage induction motors assigned to such variable conditions as is found in the pumping of liquids, etc.

Understanding Unbalance (4 of 5)

EXPLANATION OF NEMA STANDARD MGI-1973-SECTION 14.34

This standard presents guidelines on Voltage Unbalance.

While the voltages should be evenly balanced as closely as can be read on the usually available commercial voltmeter, it is recommended that any voltage unbalance at the Motor Terminals not exceed 1%.

Unbalanced Voltage can be broken into two opposing components, a positive sequence voltage and negative sequence voltage component. The positive sequence, operating the motor in its correct rotation, is opposed by the negative sequence, causing a build up of heat.

Unbalance causes extra motor losses and in turn heating of the Rotor and Windings. Increased motor losses increase power costs.

Line currents, as a result of unbalanced voltage, will be greatly unbalanced in the order of 6 to 10 times the voltage unbalance. This true value of the current unbalance will not be apparent on a normal reading, as part of the unbalance is in the form of circulating currents in the motor and does not show up in the line. It is recommended that any amperage unbalance at the motor terminals not exceed 5%.

In the phase with the highest current, the percentage increase in temperature rise will be approximately two times the square of the percentage of voltage unbalance.

• EXAMPLE

If voltage unbalance was 3%, percentage increase in temperature rise would be:

$$2 \times (3\%)^2 = 2 \times 9\% = 18\%$$

Project: Model: Chk'd: Date:

Understanding Unbalance (5 of 5)

Any significant voltage unbalance notably reduces the margins that motors have at usual service conditions, i.e. Service Factor.

Voltage Unbalance can be more harmful than short time overloading or moderate low voltage conditions.

• NOTE
If the unbalance condition cannot be corrected, it would then be advisable to reduce the motor load or oversize the motor.

EFFECT OF VOLTAGE VARIATION ON INDUCTION MOTOR CHARACTERISTICS