



Устройство для вакуумирования (воздуха) и заполнения (элегаза) Инструкция по эксплуатации (оригинал)

Тип №: 3-001-4-R002 | Комм. №: |

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DILO. Всегда герметичный.

Сделано ■
в ■
Германии ■



Общие правила безопасности

Обязательство проводить должное обслуживание

Устройство для откачки воздуха и заполнения элегазом было разработано и создано с учетом всех необходимых стандартов, а также дополнительных технических условий. Безопасное использование механизма может быть достигнуто только при соблюдении всех необходимых правил.

Оператор должен убедиться, что

- устройство используется только в тех целях, для которых оно предназначено (смотрите главу Описание продукта).
- устройство используется только в соответствии с инструкциями и находится в рабочем состоянии.
- никто не сможет получить травму в процессе эксплуатации устройства.
- персонал по проведению технического обслуживания и ремонтных работ имеет необходимую защитную одежду, которую необходимо использовать всегда.
- полные и понятные инструкции по эксплуатации имеются в распоряжении на месте использования.
- только квалифицированный персонал работает или осуществляет ремонт устройства.
- этот персонал регулярно проходит инструктаж по технике безопасности и охране окружающей среды, и что этот персонал полностью знает инструкции по эксплуатации и в частности комментарии по безопасности.
- комментарии по безопасности и предупредительные надписи на устройстве понятны и не могут быть удалены.

Описание изделия

Описание изделия – правильное использование

Устройство откачки и заправки спроектировано для откачки воздуха и заполнения газовых отсеков элегазом. Не используйте данное устройство для откачки жидкости или других газов.



Опасность

Использование данного устройства для других нужд может быть небезопасным.

Изготовитель не несет ответственности в случае повреждения или нанесения ущерба вызванного неправильной эксплуатацией устройства.

Мы рекомендуем всему персоналу, привлекаемому к эксплуатации и ремонту устройства, пройти специальное обучение.

Вакуумный насос:

Вакуумный насос позволяет откачивать воздух из газовых отсеков.

Для предотвращения повреждения, вакуумный насос должен быть защищен от избыточного давления.

Откачайте элегаз под избыточным давлением с помощью устройства откачки элегаза.

Снизьте давления воздуха или азота с помощью спускного клапана.

Вакуумный насос откачивает в только в атмосферу.

Тип спускного клапана (Тип 3-001-4-R300):

Вакуумный насос открывается только в случае если нет избыточного давления на стороне всасывания. (Техническая информация находится в инструкции по эксплуатации вакуумного насоса).

Электрические соединения:

Питание осуществляется через кабель со штекером.

Убедитесь, что двигатель отключен и питание соответствует параметрам указанным на паспортной табличке.

(Смотри описание инструкции по эксплуатации вакуумного насоса).

Габариты / Технические данные

3-001-4-R...



Рисунок: 3-001-4-R002

Номинальная всасывающая способность	Конечный вакуум	Глубина:	Ширина:	Высота:	Вес:
16 м ³ /ч	< 1 мбар	570 мм	540 мм	1370 мм	55 кг

Уровень шума:

< 60 дБ(А)

Цвет:

оранжевый RAL 2004

Рабочее напряжение:

переменный ток 100-127В или 220-240В

Частота:

50/60 Гц

Допустимая температура
окружающей среды:

0 до 45°C (Вакуумный насос Busch)

10 до 45°C (Вакуумный насос Leybold)

Электрическое соединение:

Предохранитель:	16 А
Сечение проводника:	≥ 1,5 мм ² (AWG 15)

Транспортировка / Установка / Ввод в эксплуатацию

Транспортировка:

Для предотвращения повреждения оборудования и персонала при транспортировке:



Опасность

- Такелаж должен соответствовать местным нормам по безопасности.
- Такелаж должен быть выбран в соответствии с массой оборудования. (см. Лист с размерами).
- Не стойте под грузом.
- Только квалифицированный персонал должен осуществлять транспортировку оборудования.

Транспортировать устройство только в вертикальном положении. Не транспортировать устройство в горизонтальном положении, т.к. масло из насоса может вытечь в фильтр или корпус.

Установка:



Осторожно

Использовать устройство только в помещении или в сухом месте на улице. Использование во влажных условиях может вызвать коррозию соединений и клапанов.

Для использования на улице, мы рекомендуем использовать брезентовый ч брезентовый чехол.

При использовании устройства с брезентовым чехлом, следует помнить о достаточной вентиляции устройства.

Окружающая температура для использования устройства должна быть в пределах – 10 до + 40 °C.

(см. Инструкцию по эксплуатации вакуумного насоса)

Ввод в эксплуатацию



Опасность

Только обученный персонал должен подключать устройство!

Блок питания должен быть защищен от остаточного тока с макс. рабочим током 30мА.

Для рабочего напряжения рекомендуемый предохранитель и сечение проводников: см. Лист с размерами и тех. параметрами.

Подсоедините вакуумного насос к клеммнику.

Убедитесь что двигатель отключен и класс напряжения соответствует указанному на паспортной табличке.

Заправка маслом

Перед запуском вакуумного насоса проверьте уровень масла или заправьте необходимое количество (см. Инструкцию по эксплуатации вакуум-насоса).

Заправка для транспортировки

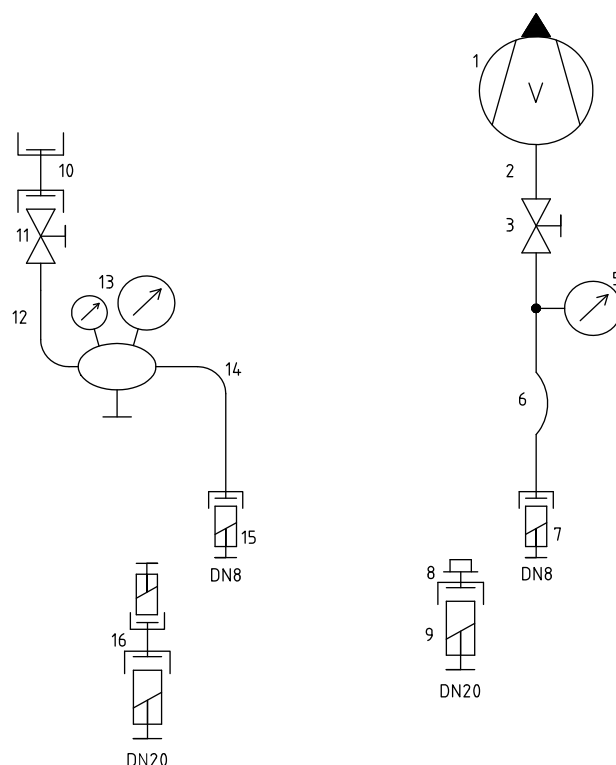
Вакуумный контур заполняется азотом (N₂) с легким избыточным давлением (~ ре 0.2 бар) на нашем предприятии.

Закрытые шланги заполнены элегазом (SF₆) с легким избыточным давлением (~ ре 0.2 бар) на нашем предприятии. Бирки дают всю необходимую информацию.

Открытые шланги заполнены воздухом и должны быть провакуумированы перед работой с элегазом (см. Раздел «Вакуумирование соединительных элегазовых шлангов»).

Функциональная схема

3-001-4-R002



Список компонентов функциональной схемы

Поз.	Наименование	№ артикула	Шт.
1	Вакуумный насос (номинальная всасывающая способность 16 м ³ /ч, конечный вакуум < 1 мбар)	3-690-R012	1
2	Армированный шланг	SM038L00500	1
3	Шаровой вентиль	3-365-R014 P	1
5	Индикатор вакуума 0 до -1200 мбар	K059R01	1
6	Армированный шланг	SM018L06000	1
7	Соединительный элемент DN 8	VK/F-02/8 P	1
8	Переходник DN8 / 20	3-240-R001 P	1
9	Соединительный элемент DN 20	VK/F-02/20 P	1
10	Соединение с резьбой W 21,8x1/14"	3-316-R001 P	1
11	Шаровой вентиль	3-365-R008 P	1
12	Армированный шланг	SM018L00700	1
13	Редуктор давления 0-10 бар	3-285-R001	1
14	Армированный шланг	SM018L06000	1
15	Соединительный элемент DN 8	VK/F-02/8 P	1
16	Соединительный элемент DN 20	6-1206-R001	1

Функциональное описание

Откачка газа из газовых отсеков

Для предотвращения смешивания воздуха с элегазом, газовые отсеки предварительно необходимо провакуумировать.

1. Подсоедините газовый отсек к шлангу и заправочному устройству.



Осторожно

При избыточном давлении элегаза необходимо его откачать.

2. Включите вакуумный насос.
3. Медленно откройте шариковый клапан.
4. Когда необходимое значение вакуума достигнуто, закройте клапан.
5. Остановите вакуумный насос.

Значения вакуума поз.3

Показания датчика без компенсации давления, поэтому показания могут зависеть от окружающего давления воздуха. При атмосферном давлении показания равны 0 мбар. При вакууме 0-1 мбар – показания отрицательного давления.

Пример:

При атмосферном давлении 950 мбар датчик отображает –950 мбар (при вакууме 0-1 мбар).



Функциональное описание

Заправка газового отсека элегазом

Для предотвращения смешивания воздуха с элегазом, перед первым использованием все шланги необходимо провакуумировать.

1. Откройте вентиль на баллоне с элегазом.
2. Настройте редуктор на необходимое давление заполнения.
3. Закройте вентиль на баллоне с элегазом.
4. Подсоедините заправочный шланг к газовому отсеку.
5. Откройте вентиль на баллоне с элегазом.
6. После достижения установленного давления закройте вентиль на баллоне с элегазом.
7. Отсоедините газовый отсек.



Функциональное описание

Вакуумирование шланга подсоединённого к баллону с элегазом

Перед вводом в работу открытые шланги заполнения должны быть вакуумированы. Для этих целей используется соединительный адаптер 6-1059-R012.

1. Закройте шаровой клапан баллона с элегазом.
2. Отсоедините от обоих шлангов соединение DN20.
3. Подсоедините оба шланга к адаптеру 6-1059-R012.
4. Запустите вакуумный насос.
5. Медленно откройте шаровой клапан.
6. После достижения требуемого конечного вакуума закройте шаровой клапан.
7. Остановите вакуумный насос.
8. Снимите адаптер.

Шланг заполнения вакуумирован и может быть соединён с отсеком с элегазом.

Техническое обслуживание и функциональная проверка

В случае возникновения неисправности или при невозможности запустить устройство ремонтные работы и техническое обслуживание должны быть проведены только квалифицированным и специально обученным персоналом.

Проинформируйте об отказе руководителя работ. Устранение неисправностей на электрическом оборудовании должно проводиться только квалифицированным и специально обученным персоналом (см. Раздел 1).

Во избежание поражения электрическим током:



Опасность

- Только специально обученные электрики должны проводить технические и ремонтные работы на электрическом оборудовании.
- Перед проведением процедур технического обслуживания и ремонтных работ вытащите из розетки питающий кабель и соблюдайте осторожность при вставлении его обратно.
- Оператор должен заниматься устранением только тех неисправностей, которые возникли в результате нарушений правил эксплуатации и текущего обслуживания.

Неисправность	Возможная причина	Устранение
Вакуумный насос не достигает предельного вакуума	Восходящий поток электромагнитного клапана или шарового клапана из вакуумного насоса перекрыт	Проверьте положение электромагнитных клапанов или шаровых клапанов
	Недостаточно масла	Долейте масла
	Неподходящее масло	Замените масло и фильтр
	Влажность в масле (масло белого цвета)	
	Неисправный вакуумный контролер или датчик (специальная модель)	Замените вакуумный контролер или датчик

Техническое обслуживание



Опасность

- Очистка, смазывание и техническое обслуживание должны выполняться только специально обученным персоналом в соответствии с инструкциями по техническому обслуживанию и правилам техники безопасности. Несоблюдение этих инструкций может привести к получению травм или смерти или нанесению существенного вреда оборудованию.
- Проводите техническое обслуживание, только когда устройство выключено.
- Дотрагивайтесь до деталей насоса только после того, как он остыл.

Соблюдайте нормы по охране окружающей среды

Каждый раз при работе с устройством, пожалуйста, соблюдайте юридические нормы по удалению отходов.

В частности во время установки, ремонтных работ или технического обслуживания рабочие вещества, например, масла вакуумного насоса, которые могут привести к загрязнению воды, не должны загрязнять почву или спускаться в дренажные каналы. Эти вещества должны храниться в соответствующих резервуарах и удаляться в соответствии с местными нормами.

Техническое обслуживание и функциональная проверка

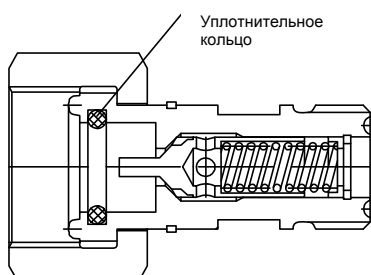
Профилактическое обслуживание

Деталь	Технические работы	Рекомендованный интервал регулирования
Вакуумный насос	Проверьте уровень масла	Ежедневно или перед каждой операцией
Вакуумный насос	1-ая Замена масла	После 100 операционных часов
	Дальнейшие замены масла	Каждые 500-2000 часов или каждый год, смотрите инструкции по эксплуатации вакуумного насоса
	Фильтрующий элемент	При каждой 2-ой замене масла

Общее руководство по эксплуатации шлангов

- Шланги, используемые на тележке обслуживания, время от времени необходимо проверять на герметичность. Для этой цели следует выполнить два следующих теста:
 - Тест на давление
Присоедините шланг таким образом, чтобы манометр показывал давление. Шланг должен находиться под давлением. Убедитесь по показаниям манометра, что давление не падает.
 - Вакуумный тест
Присоедините шланг к вакуумному насосу. Одновременно присоедините подходящий вакуумный манометр. Создайте вакуум после выключения вакуумного насоса, при постоянной комнатной температуре показание вакуумного манометра не должно изменяться.
- На хвостовике штуцеров DILO Ду8 и Ду20 имеется кольцевое уплотнение, которое обеспечивает внешнее уплотнение во время присоединения к муфте. Поскольку кольцевое уплотнение используется каждый раз, когда производится присоединение к муфте, оно подвергается износу и поэтому необходимо время от времени производить его замену.

3.



Уплотнительное кольцо для хвостовика штуцера Ду8:

Номер для заказа: 1-05-057-R024

Размер: ВД 13,95 x Ш 2,62 EPDM

Уплотнительное кольцо для хвостовика штуцера Ду20:

Номер для заказа: 1-05-057-R010

Размер: ВД 20,29 x Ш 2,62 EPDM

- Для того чтобы защитить соединительный шланг и систему трубопроводов от загрязнения продуктами разложения, мы рекомендуем использовать **предварительный фильтр**.

Техническое обслуживание и функциональная проверка

Внимание:

При использовании соединительных муфт необходимо использовать противодействующую силу стопорения для предотвращения самопроизвольного проворачивания соединительных муфт.

Затягивание соединительных элементов можно производить вручную либо с помощью ключа. См. рисунок.



Запасные детали:

<input type="checkbox"/> Масло для вакуумного насоса (бутылка емкостью 1л)	3-690-R221
<input type="checkbox"/> Фильтрующий элемент для вакуумного насоса	3-690-R301
<input type="checkbox"/> Комплект запасных частей для вакуумного насоса	6-1005-R101
<input type="checkbox"/> Выпускной клапан для вакуумного насоса	3-690-R111



Installation and Operating Instructions



Vacuum Pumps
R 5 KA/KC 0010,0016 C



Busch Produktions GmbH
Schauinslandstr. 1
79689 Maulburg
Germany

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Preface

Congratulations on your purchase of the Busch vacuum pump. With watchful observation of the field's requirements, innovation and steady development Busch delivers modern vacuum and pressure solutions worldwide.

These operating instructions contain information for

- product description,
- safety,
- transport,
- storage,
- installation and commissioning,
- maintenance,
- overhaul,
- troubleshooting and
- spare parts

of the vacuum pump.

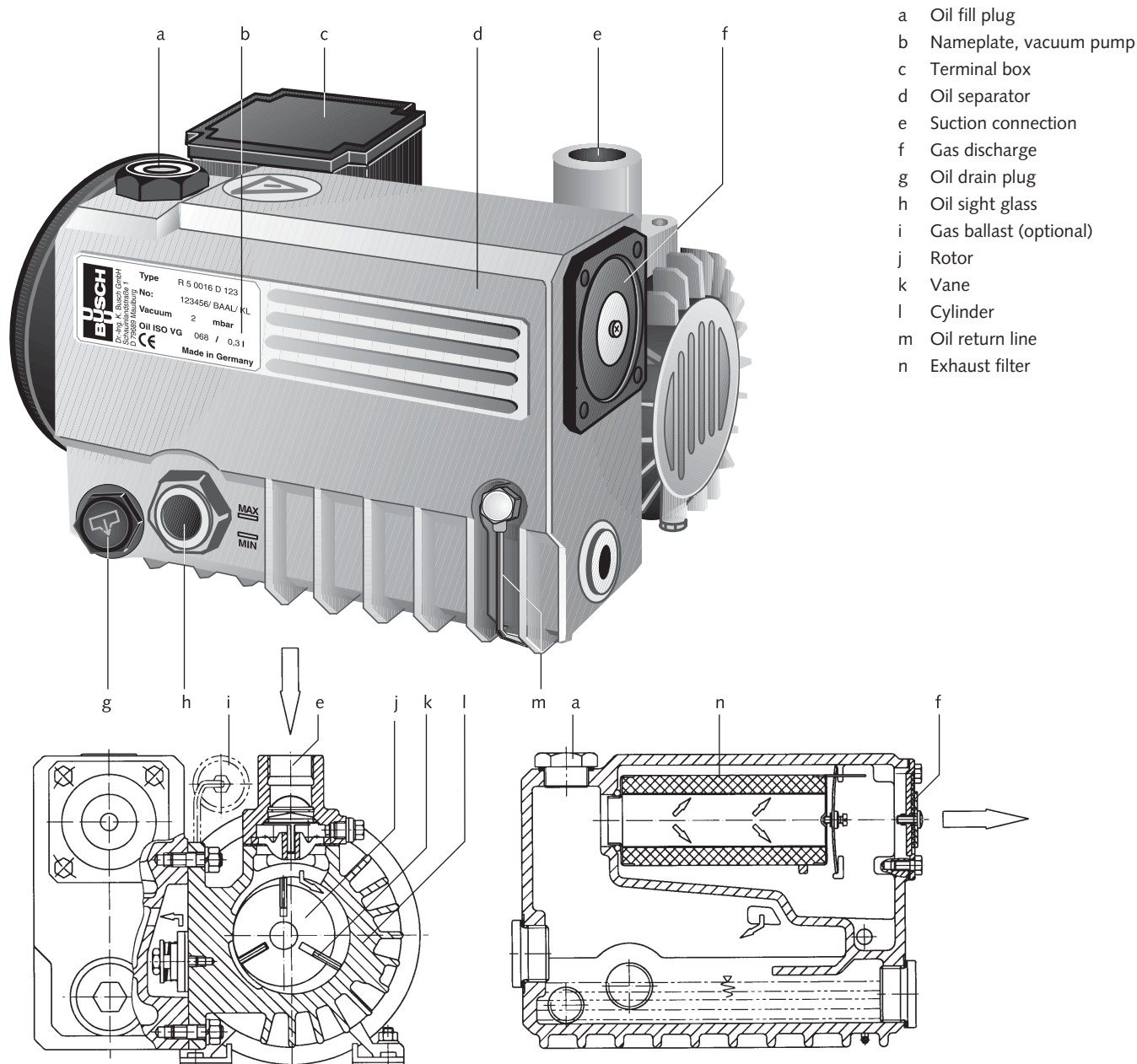
For the purpose of these instructions, "handling" the vacuum pump means the transport, storage, installation, commissioning, influence on operating conditions, maintenance, troubleshooting and overhaul of the vacuum pump.

Prior to handling the vacuum pump these operating instructions shall be read and understood. If anything remains to be clarified please contact your Busch representative!

Keep these operating instructions and, if applicable, other pertinent operating instructions available on site.

Technical Data

Nominal suction capacity (50Hz/60Hz)	m ³ /h	K.. 0010 C: 10 / 12 K.. 0016 C: 16 / 19
Ultimate pressure	hPa (=mbar) abs.	KA ... C: 0.5 KC ... C: 20
Motor nominal rating (50Hz/60Hz)	kW	K.. 0010 C: 0.37 K.. 0016 C: 0.55
Motor nominal speed (50Hz/60Hz)	min ⁻¹	1500 / 1800
Sound pressure level (EN ISO 2151) (50Hz/60Hz)	dB (A)	K.. 0010 C: 57 / 59 K.. 0016 C: 59 / 60
Operating temperature (50Hz/60Hz)	°C	K.. 0010 C: 77 / 82 K.. 0016 C: 86 / 90
Ambient temperature range	°C	12 ... 30
Ambient pressure		Atmospheric pressure
Oil quantity	l	0.3
Weight approx. (50Hz/60Hz)	kg	K.. 0010 C: ~18 K.. 0016 C: ~20



Product Description

Use

The vacuum pump is intended for

- the suction
- of
- air and other dry, non-aggressive, non-toxic and non-explosive gases

Conveying media with a lower or higher density than air leads to an increased thermal and/or mechanical load on the vacuum pump and is permissible only after prior consultation with Busch.

In case the vacuum pump is equipped with a gas ballast (optional) water vapour within the gas flow can be tolerated within certain limits (→ page 8: Conveying Condensable Vapours). The conveyance of other vapours shall be agreed upon with Busch.

The vacuum pump is intended for the placement in a non-potentially explosive environment.

Version with oil return line to the suction connection (KC C):

The vacuum pump is thermally suitable for continuous operation (100 percent duty).

Version with oil return valve (KA ... C):

The vacuum pump is thermally suitable for continuous operation (observe the notes with regard to the oil recirculation: → page 4: Oil Circulation; → page 8: Oil Return).

The vacuum pump is ultimate pressure proof.

Principle of Operation

The vacuum pump works on the rotating vane principle.

A circular rotor is positioned centrally on the shaft of the vacuum pump (i.e. drive motor shaft).

The rotor rotates in an also circular, fixed cylinder, the centreline of which is offset from the centreline of the rotor such that the rotor and the inner wall of the cylinder almost touch along a line. Vanes, sliding in slots in the rotor, separate the space between the rotor and the cylinder into chambers. At any time gas is sucked in and at almost any time ejected. Therefore the vacuum pump works almost pulsation free.

In order to avoid the suction of solids, the vacuum pump is equipped with a screen in the suction connection.

In order to avoid reverse rotation after switching off, the vacuum pump is equipped with a non-return valve.

Note: This valve shall not be used as a non-return valve or shut-off valve to the vacuum system and is no reliable means to prevent suction of oil into the vacuum system while the vacuum pump is shut down.

In case the vacuum pump is equipped with a gas ballast (optional):

Through the gas ballast a small amount of ambient air is sucked into the pump chamber and compressed together with the process gas. This counteracts the accumulation of condensates from the process gas inside the vacuum pump (→ page 8: Conveying Condensable Vapours).

The gas ballast line is equipped with a paper filter.

In order to improve the operating characteristics the outlet of the pump chamber is equipped with a spring loaded valve.

Oil Circulation

The vacuum pump requires oil to seal the gaps, to lubricate the vanes and to carry away compression heat.

The oil reservoir is located on the pressure side of the vacuum pump (i.e. high pressure) at the bottom of the bottom chamber of the oil separator.

The feed openings are located on the suction side of the vacuum pump (i.e. low pressure).

Forced by the pressure difference between pressure side and suction side oil is being drawn from the oil separator through the oil supply lines and injected on the suction side.

Together with the sucked gas the injected oil gets conveyed through the vacuum pump and ejected into the oil separator as oil mist. Oil that separates before the exhaust filter accumulates at the bottom of the bottom chamber of the oil separator.

Oil that is separated by the exhaust filter accumulates at the bottom of the upper chamber of the oil separator.

The flow resistance of the exhaust filters causes the inside of the exhaust filters (which is connected to the bottom chamber of the oil separator) to be on a higher pressure level than the outside of the exhaust filters (i.e. the upper chamber of the oil separator). Because of the higher pressure in the bottom chamber it is not possible to let oil that drips off the exhaust filters simply flow down to the bottom chamber.

Version with oil return line to the suction connection (KC C):

Therefore the oil that accumulates in the upper chamber is sucked through the oil return line right to the suction connection.

Version with oil return valve (KA ... C):

At continuous operation this would cause the entire supply of oil to accumulate at the bottom of the upper chamber, expel oil droplets through the gas discharge/pressure connection and let the vacuum pump run dry. Therefore the vacuum pump must be shut down at the latest after 2 hours of continuous operation, depending on the operating conditions even after a shorter period, for at least approx. 15 minutes (→ page 8: Operation Notes). After turning off the vacuum pump the pressure difference between the inside and the outside of the exhaust filter(s) collapses, hence the two chambers of the oil separator assume an equal pressure level, the oil return valve between the two chambers opens and the accumulated oil in the upper chamber can run down to the bottom chamber.

Cooling

The vacuum pump is cooled by

- radiation of heat from the surface of the vacuum pump incl. oil separator
- the air flow from the fan wheel of the drive motor
- the process gas

Start Controls

The vacuum pump comes without start controls. The control of the vacuum pump is to be provided in the course of installation.

Safety

Intended Use

Definition: For the purpose of these instructions, "handling" the vacuum pump means the transport, storage, installation, commissioning, influence on operating conditions, maintenance, troubleshooting and overhaul of the vacuum pump.

The vacuum pump is intended for industrial use. It shall be handled only by qualified personnel.

The allowed media and operational limits (→ page 3: Product Description) and the installation prerequisites (→ page 6: Installation Prerequisites) of the vacuum pump shall be observed both by the manufacturer of the machinery into which the vacuum pump is to be incorporated and by the operator.

The maintenance instructions shall be observed.

Prior to handling the vacuum pump these installation and operating instructions shall be read and understood. If anything remains to be clarified please contact your Busch representative!

Safety Notes

The vacuum pump has been designed and manufactured according to state-of-the-art methods. Nevertheless, residual risks may remain. These operating instructions highlight potential hazards where appropriate. Safety notes are tagged with one of the keywords DANGER, WARNING and CAUTION as follows:



DANGER

Disregard of this safety note will always lead to accidents with fatal or serious injuries.



WARNING

Disregard of this safety note may lead to accidents with fatal or serious injuries.



CAUTION

Disregard of this safety note may lead to accidents with minor injuries or property damage.

Emission of Oil Mist



CAUTION

The non-OEM spares market offers exhaust filters that are geometrically compatible with Busch-vacuum pumps, but do not feature the high retention capacity of genuine Busch-exhaust filters.

Increased risk of damage to health.

In order to keep the emission on the lowest possible level only genuine Busch-exhaust filters shall be used.

The oil in the process gas is separated to the greatest possible extent, but not perfectly.



CAUTION

The gas conveyed by the vacuum pump contains remainders of oil.

Aspiration of process gas over extended periods can be harmful.

The room into which the process gas is discharged must be sufficiently vented.

Note: The possibly sensible smell is not caused by droplets of oil, though, but either by gaseous process components or by readily volatile and thus gaseous components of the oil (particularly additives).

Noise Emission

For the sound pressure level in free field according to EN ISO 2151
→ page 2: Technical Data.

Transport

Note: Also a vacuum pump, that is not topped up with oil contains residues of oil (from the test run). Always transport and store the vacuum pump in upright position. Do not put the vacuum pump on its side nor put it upside down.

Transport in Packaging

Packed on a pallet the vacuum pump is to be transported with a forklift.

Transport without Packaging

In case the vacuum pump is packed in a cardboard box with inflated cushions:

- ◆ Remove the inflated cushions from the box

In case the vacuum pump is in a cardboard box cushioned with rolled corrugated cardboard:

- ◆ Remove the corrugated cardboard from the box

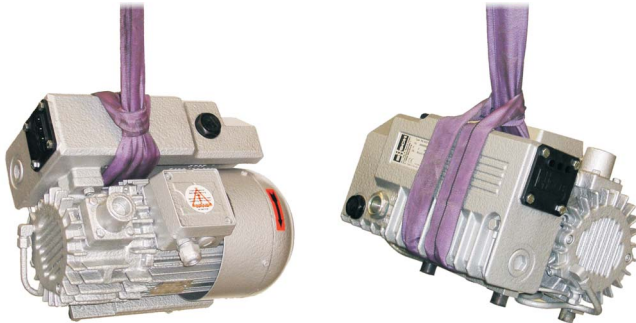
In case the vacuum pump is laid in foam:

- ◆ Remove the foam

- Grasp the vacuum pump with both hands
- Attach lifting gear securely to the eyelets on the base frame
- Attach another belt/rope as a protection against overturning to a suitable point (eyebolt, drive motor flange etc.)

Alternatively:

- Insert a belt/rope between the oil separator and the cylinder and loop it around the oil separator (→ illustration)



In case lifting gear is used:

- ◆ Attach the lifting gear to a crane hook with safety latch
- Loosely hang the additional belt/rope into the crane hook



CAUTION

Tilting a vacuum pump that is already filled with oil can cause large quantities of oil to ingress into the cylinder.

Starting the vacuum pump with excessive quantities of oil in the cylinder will immediately break the vanes and ruin the vacuum pump.

Once the vacuum pump is filled with oil it shall not be lifted anymore.

- Prior to every transport make sure that the oil is drained

Storage

Short-term Storage

Version with gas ballast without ball-valve, with paper filter:

- ◆ Close the paper filter of the gas ballast device with adhesive tape
- Make sure that the suction connection and the gas discharge are closed (leave the provided plugs in)
- Store the vacuum pump
 - if possible in original packaging,
 - indoors,
 - dry,
 - dust free and
 - vibration free

Conservation

In case of adverse ambient conditions (e.g. aggressive atmosphere, frequent temperature changes) conserve the vacuum pump immediately. In case of favourable ambient conditions conserve the vacuum pump if a storage of more than 3 months is scheduled.

During the test run in the factory the inside of the vacuum pump was completely wetted with oil. Under normal conditions a treatment with conservation oil is therefore not required. In case it is advisable to treat the vacuum pump with conservation oil because of very adverse storage conditions, seek advice from your Busch representative!

Version with gas ballast without ball-valve, with paper filter:

- ◆ Close the paper filter of the gas ballast with adhesive tape
- Make sure that all ports are firmly closed; seal all ports that are not sealed with PTFE-tape, gaskets or o-rings with adhesive tape

Note: VCI stands for “volatile corrosion inhibitor”. VCI-products (film, paper, cardboard, foam) evaporate a substance that condenses in molecular thickness on the packed good and by its electro-chemical properties effectively suppresses corrosion on metallic surfaces. However, VCI-products may attack the surfaces of plastics and elastomers. Seek advice from your local packaging dealer! Busch uses CORTEC VCI 126 R film for the overseas packaging of large equipment.

- Wrap the vacuum pump in VCI film
- Store the vacuum pump
 - if possible in original packing,
 - indoors,
 - dry,
 - dust free and
 - vibration free.

For commissioning after conservation:

- Make sure that all remains of adhesive tape are removed from the ports
- Commission the vacuum pump as described in the chapter Installation and Commissioning (→ page 6)

Installation and Commissioning

Installation Prerequisites



CAUTION

In case of non-compliance with the installation prerequisites, particularly in case of insufficient cooling:

Risk of damage or destruction of the vacuum pump and adjoining plant components!

Risk of injury!

The installation prerequisites must be complied with.

- Make sure that the integration of the vacuum pump is carried out such that the essential safety requirements of the Machine Directive 2006/42/EC are complied with (in the responsibility of the designer of the machinery into which the vacuum pump is to be incorporated; → page 19: note in the EC-Declaration of Conformity)

Mounting Position and Space

- Make sure that the environment of the vacuum pump is not potentially explosive
- Make sure that the following ambient conditions will be complied with:
 - ambient temperature: 12 ... 30 °CIf the vacuum pump is installed in a colder environment than allowed with the oil used:
 - ◆ Fit the vacuum pump with a temperature switch and control the vacuum pump such that it will start automatically when the oil sump temperature falls below the allowed temperature
- ambient pressure: atmospheric
- Make sure that the environmental conditions comply with the protection class of the drive motor (according to the nameplate)
- Make sure that the vacuum pump will be placed or mounted horizontally
- Make sure that in order to warrant a sufficient cooling there will be a clearance of minimum 20 cm between the vacuum pump and nearby walls
- Make sure that no heat sensitive parts (plastics, wood, cardboard, paper, electronics) will touch the surface of the vacuum pump
- Make sure that the installation space or location is vented such that a sufficient cooling of the vacuum pump is warranted



CAUTION

During operation the surface of the vacuum pump may reach temperatures of more than 70 °C.

Risk of burns!

- Make sure that the vacuum pump will not be touched inadvertently during operation, provide a guard if appropriate
 - Make sure that the sight glass will remain easily accessible
- If the oil change is meant to be performed on location:
- ◆ Make sure that the drain port and the filling port will remain easily accessible
 - Make sure that enough space will remain for the removal and the reinsertion of the exhaust filter

Suction Connection



CAUTION

Intruding foreign objects or liquids can destroy the vacuum pump.

In case the inlet gas can contain dust or other foreign solid particles:

- ◆ Make sure that a suitable filter (5 micron or less) is installed upstream the vacuum pump
- Make sure that the suction line fits to the suction connection of the vacuum pump
- Make sure that the gas will be sucked through a vacuum-tight flexible hose or a pipe

In case of using a pipe:

- ◆ Make sure that the pipe will cause no stress on the vacuum pump's connection, if necessary use an expansion joint
- Make sure that the line size of the suction line over the entire length is at least as large as the suction connection of the vacuum pump

In case of very long suction lines it is prudent to use larger line sizes in order to avoid a loss of efficiency. Seek advice from your Busch representative!

If two or more vacuum pumps work on the same suction line, if the volume of the vacuum system is large enough to suck back oil or if the vacuum shall be maintained after switching off the vacuum pump:

- ◆ Provide a manual or automatic operated valve (= non-return valve) in the suction line

(the standard non-return valve that is installed inside the suction connection is not meant to be used for this purpose!)

If the vacuum pump is planned to be used for the suction of gas that contains limited quantities of condensable vapour:

- ◆ Provide a shut-off valve, a drip-leg and a drain cock in the suction line, so that condensates can be drained from the suction line
- Make sure that the suction line does not contain foreign objects, e.g. welding scales



CAUTION

The discharged gas contains small quantities of vacuum oil.

Staying in vacuum oil contaminated air bears a risk of damage to health.

If air is discharged into rooms where persons stay, sufficient ventilation must be provided for.

Electrical Connection / Controls

- Make sure that the stipulations acc. to the EMC-Directive 2004/108/EC and Low-Voltage-Directive 2006/95/EC as well as the EN-standards, electrical and occupational safety directives and the local or national regulations, respectively, are complied with (this is the responsibility of the designer of the machinery into which the vacuum pump is to be incorporated; → page 19: note in the EC-Declaration of Conformity).
- Make sure that the power supply for the drive motor is compatible with the data on the nameplate of the drive motor
- Make sure that an overload protection according to EN 60204-1 is provided for the drive motor
- Make sure that the drive of the vacuum pump will not be affected by electric or electromagnetic disturbance from the mains; if necessary seek advice from the Busch service

In case of mobile installation:

- ◆ Provide the electrical connection with grommets that serve as strain-relief

Installation

Mounting

- Make sure that the Installation Prerequisites (→ page 6) are complied with
- Set down or mount the vacuum pump at its location

Connecting Electrically



WARNING

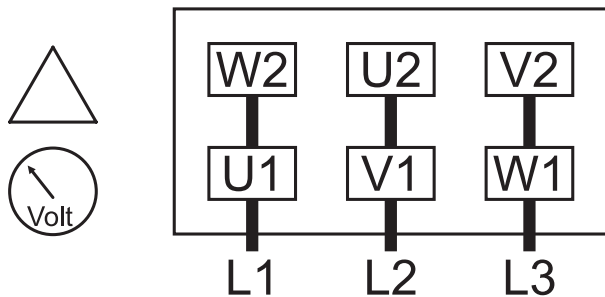
Risk of electrical shock, risk of damage to equipment.

Electrical installation work must only be executed by qualified personnel that knows and observes the following regulations:
- IEC 364 or CENELEC HD 384 or DIN VDE 0100, respectively,
- IEC-Report 664 or DIN VDE 0110,
- BGV A2 (VBG 4) or corresponding national accident prevention regulation.

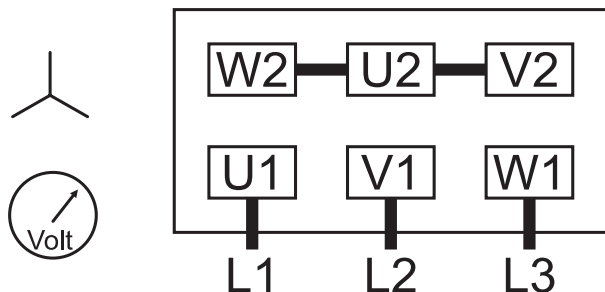
- Electrically connect the drive motor
- Connect the protective earth conductor

Connection Scheme Three-Phase Motor

Delta connection (low voltage):



Star connection (high voltage):



CAUTION

Operation in the wrong direction of rotation can destroy the vacuum pump in short time.

Prior to starting-up it must be made sure that the vacuum pump is operated in the proper direction.

Version with three-phase motor:

- ◆ Determine the intended direction of rotation with the arrow (stuck on or cast)
- ◆ "Bump" the drive motor
- ◆ Watch the fan wheel of the drive motor and determine the direction of rotation just before the fan wheel stops

If the rotation must be changed:

- ◆ Switch any two of the drive motor wires (three-phase motor)

Connecting Lines/Pipes

In case the suction line is equipped with a shut-off valve:

- ◆ Connect the suction line
- Make sure that the gas discharge is open
- Make sure that all provided covers, guards, hoods etc. are mounted
- Make sure that cooling air inlets and outlets are not covered or obstructed and that the cooling air flow is not affected adversely in any other way

Filling Oil

In case the vacuum pump was treated with conservation oil:

- ◆ Drain the remainders of conservation oil



CAUTION

The vacuum pump is shipped without oil.

Operation without oil will ruin the vacuum pump in short time.

Prior to commissioning it must be made positively sure that oil is filled in.

The vacuum pump is delivered without oil (oil specification → page 18: Oil).

- Keep approx. 0.3 litres oil acc. to the table Oil (→ page 18) ready
- Note:** The amount given in these operating instructions is a guide. The sight glass indicates the actual amount to be filled in.



CAUTION

Filling oil through the suction connection will result in breakage of the vanes and destruction of the vacuum pump.

Oil may be filled through the filling port only.



CAUTION

During operation the oil separator is filled with hot, pressurised oil mist.

Risk of injury from hot oil mist with open filling port.

Risk of injury if a loosely inserted filling plug is ejected.

Remove the filling plug only if the vacuum pump is stopped.

The vacuum pump must only be operated with the filling plug firmly inserted.

- Remove the filling plug
- Fill in approx. 0.3 litres of oil
- Make sure that the level is between the MIN and the MAX-markings of the sight glass
- Make sure that the seal ring is inserted into the filling plug and undamaged, replace if necessary
- Firmly reinsert the filling plug together with the seal ring

Note: Starting the vacuum pump with cold oil is made easier when at this very moment the suction line is neither closed nor covered with a rubber mat.

- Switch on the vacuum pump

In case the suction line is equipped with a shut-off valve:

- ◆ Close the shut-off valve

In case the suction line is not equipped with a shut-off valve:

- ◆ Cover the suction connection with a piece of rubber mat

- Let the vacuum pump run for a few minutes
- Shut down the vacuum pump and wait a few minutes
- Check that the level is between the MIN and the MAX-markings of the sight glass

In case the level has dropped below the MIN-marking:

- ◆ Top-up oil

In case the suction line is equipped with a shut-off valve:

- ◆ Open the shut-off valve

In case the suction line is not equipped with a shut-off valve:

- ◆ Remove the piece of rubber mat and connect the suction line

Recording of Operational Parameters

As soon as the vacuum pump is operated under normal operating conditions:

- Measure the drive motor current and record it as reference for future maintenance and troubleshooting work

Version with exhaust filter pressure gauge:

- ◆ Read the scale of the exhaust filter pressure gauge and record it as reference for future maintenance and troubleshooting work (→ page 10: Checks during Operation)

Operation Notes

Use



CAUTION

The vacuum pump is designed for operation under the conditions described below.

In case of disregard risk of damage or destruction of the vacuum pump and adjoining plant components!

Risk of injury!

The vacuum pump must only be operated under the conditions described below.

The vacuum pump is intended for

- the suction
- of
- air and other dry, non-aggressive, non-toxic and non-explosive gases

Conveying media with a lower or higher density than air leads to an increased thermal and/or mechanical load on the vacuum pump and is permissible only after prior consultation with Busch.

In case the vacuum pump is equipped with a gas ballast (optional) water vapour within the gas flow can be tolerated within certain limits (→ page 8: Conveying Condensable Vapours). The conveyance of other vapours shall be agreed upon with Busch.

The vacuum pump is intended for the placement in a non-potentially explosive environment.

Version with oil return line to the suction connection (KC C):

The vacuum pump is thermally suitable for continuous operation (100 percent duty).

Version with oil return valve (KA ... C):

The vacuum pump is thermally suitable for continuous operation (observe the notes with regard to the oil recirculation: → page 4: Oil Circulation; → page 8: Oil Return).

The vacuum pump is ultimate pressure proof.



CAUTION

During operation the surface of the vacuum pump may reach temperatures of more than 70 °C.

Risk of burns!

The vacuum pump shall be protected against contact during operation, it shall cool down prior to a required contact or heat protection gloves shall be worn.



CAUTION

The gas conveyed by the vacuum pump contains remainders of oil.

Aspiration of process gas over extended periods can be harmful.

The room into which the process gas is discharged must be sufficiently vented.

- Make sure that all provided covers, guards, hoods etc. remain mounted
- Make sure that protective devices will not be disabled
- Make sure that cooling air inlets and outlets will not be covered or obstructed and that the cooling air flow will not be affected adversely in any other way
- Make sure that the installation prerequisites (→ page 6: Installation Prerequisites) are complied with and will remain complied with, particularly that a sufficient cooling will be ensured

Oil Return

Only for version with oil return valve (KA ... C):

During operation oil accumulates at the bottom of the upper chamber of the oil separator, which cannot flow down into the bottom chamber, as long as the vacuum pump runs (for detailed description: → page 4: Oil Circulation).

At the latest after 2 hours of continuous operation, in case of high pressure difference between suction side and pressure side after a shorter period, the vacuum pump must be shut down for at least 15 minutes, so that the oil can run down from the upper chamber of the oil separator into the bottom chamber. **Note:** This is a good time to check the temperature, the level and the colour of the oil.

Conveying Condensable Vapours



CAUTION

Residual condensates dilute the oil, deteriorate its lubricating properties and can cause a seizure of the rotor.

Apply a suitable operating method to make sure that no condensates remain in the vacuum pump.

In order to use the vacuum pump for the conveyance of condensable vapours, the vacuum pump must be equipped with a shut-off valve in the suction line and with a gas ballast.

- Close the shut-off valve in the suction line
- Operate the vacuum pump with the suction line shut off for approx. half an hour, so that the operating temperature rises to approx. 75 °C

At process start:

- Open the shut-off valve in the suction line

At the process end:

- Close the shut-off valve in the suction line
- Operate the vacuum pump for another approx. half an hour

Maintenance



DANGER

In case the vacuum pump conveyed gas that was contaminated with foreign materials which are dangerous to health, harmful material can reside in filters.

Danger to health during inspection, cleaning or replacement of filters.

Danger to the environment.

Personal protective equipment must be worn during the handling of contaminated filters.

Contaminated filters are special waste and must be disposed of separately in compliance with applicable regulations.



CAUTION

During operation the surface of the vacuum pump may reach temperatures of more than 70 °C.

Risk of burns!

- Prior to action that requires touching of the vacuum pump, let the vacuum pump cool down, however, if the oil is to be drained, for no more than 20 minutes (the oil shall still be warm when being drained)
- Prior to disconnecting connections make sure that the connected pipes/lines are vented to atmospheric pressure

Maintenance Schedule

Note: The maintenance intervals depend very much on the individual operating conditions. The intervals given below shall be considered as starting values which should be shortened or extended as appropriate. Particularly heavy duty operation, such like high dust loads in the environment or in the process gas, other contaminations or ingress of process material, can make it necessary to shorten the maintenance intervals significantly.

Daily:

- Check the level and the colour of the oil (→ page 9: Checking the Oil)

Weekly:

- Check the vacuum pump for oil leaks - in case of leaks have the vacuum pump repaired (Busch service)

Monthly:

- Check the function of the exhaust filter (→ page 10: Exhaust Filter)
- Make sure that the vacuum pump is shut down and locked against inadvertent start up

In case an inlet air filter is installed:

- ◆ Check the inlet air filter, if necessary replace

In case of operation in a dusty environment:

- ◆ Clean as described under → page 9: Every 6 Months:

Every 6 Months:

- Make sure that the housing is free from dust and dirt, clean if necessary
- Make sure that the vacuum pump is shut down and locked against inadvertent start up
- Clean the fan cowling, the fan wheel, the ventilation grille and the cooling fins

Every Year:

- Make sure that the vacuum pump is shut down and locked against inadvertent start up

- Replace the exhaust filter (→ page 10: Exhaust Filter)

In case an inlet air filter is installed:

- ◆ Replace the inlet air filter

- Check the inlet screen, clean if necessary

Version with gas ballast with paper filter:

- ◆ Replace the filter

Every 500 - 2000 Operating Hours:

(→ page 10: Oil Life):

- Change the oil (→ page 10: Oil Change)

Checking the Oil

Checking the Level

- Make sure that the vacuum pump is shut down and the oil has collected at the bottom of the oil separator
- Read the level on the sight glass

In case the level has dropped underneath the MIN-marking:

- ◆ Top up oil (→ page 9: Topping up Oil)

In case the level exceeds the MAX-marking:

- ◆ Excessive dilution with condensates - change the oil and check the process
- ◆ If appropriate retrofit a gas ballast (Busch Service) and observe the chapter Conveying Condensable Vapours (→ page 8)

In case the level exceeds the MAX-marking despite proper use of the gas ballast:

- ◆ Replace the filter

Topping up Oil

Note: Under normal conditions there should be no need to top up oil during the recommended oil change intervals. A significant level drop indicates a malfunction (→ page 13: Troubleshooting).

Note: During operation the exhaust filter gets saturated with oil. It is therefore normal that the oil level will drop slightly after replacement of the exhaust filter.



CAUTION

Filling oil through the suction connection will result in breakage of the vanes and destruction of the vacuum pump.

Oil may be filled through the filling port only.



CAUTION

During operation the oil separator is filled with hot, pressurised oil mist.

Risk of injury from hot oil mist with open filling port.

Risk of injury if a loosely inserted filling plug is ejected.

Remove the filling plug only if the vacuum pump is stopped.

The vacuum pump must only be operated with the filling plug firmly inserted.

- Make sure that the vacuum pump is shut down and locked against inadvertent start up
- Remove the filling plug
- Top up oil until the level reaches the middle of the sight glass
- Make sure that the seal ring is inserted into the filling plug and undamaged, replace if necessary
- Firmly reinsert the filling plug together with the seal ring

Checking the Colour of the Oil

Note: The oil should be light, either transparent, a little foamy or a little tarnished. A milky discolouration that does not vanish after sedation of the oil indicates contamination with foreign material. Oil that is either contaminated with foreign material or burnt must be changed (→ page 10: Oil Change).

In case the oil appears to be contaminated with water or other condensates despite proper use of the gas ballast:

- ◆ Replace the filter

Oil Life

The oil life depends very much on the operating conditions. A clean and dry air stream and operating temperatures below 100 °C are ideal. Under these conditions the oil shall be changed every 500 to 2000 operating hours or after half a year.

Under very unfavourable operating conditions the oil life can be less than 500 operating hours. Extremely short life times indicate malfunctions (→ page 13: Troubleshooting) or unsuitable operating conditions, though.

Choosing a synthetic oil instead of a mineral oil can extend the oil life. To select the oil best suited oil for your process please contact your Busch representative.

If there is no experience available with regard to the oil life under the prevailing operation conditions, it is recommended to have an oil analysis carried out every 500 operating hours and establish the change interval accordingly.

Oil Change



In case the vacuum pump conveyed gas that was contaminated with harmful foreign material the oil will be contaminated with harmful material.

Danger to health during the changing of contaminated oil.

Danger to the environment.

Personal protective equipment must be worn during the changing of contaminated oil.

Contaminated oil is special waste and must be disposed of separately in compliance with applicable regulations.

Draining Used Oil

Note: After switching off the vacuum pump at normal operating temperature wait no more than 20 minutes before the oil is drained (the oil shall still be warm when being drained).

- Make sure that the vacuum pump is shut down and locked against inadvertent start up
- Make sure that the vacuum pump is vented to atmospheric pressure
- Put a drain tray underneath the drain port
- Remove the drain plug and drain the oil

When the oil stream dwindles:

- Reinsert the drain plug
- Switch the vacuum pump on for a few seconds
- Make sure that the vacuum pump is shut down and locked against inadvertent start up
- Remove the drain plug again and drain the remaining oil
- Make sure that the seal ring is inserted into the drain plug and undamaged, replace if necessary
- Firmly reinsert the drain plug together with the seal ring
- Dispose of the used oil in compliance with applicable regulations

Flushing the Vacuum Pump



Degraded oil can choke pipes and coolers.

Risk of damage to the vacuum pump due to insufficient lubrication.

Risk of explosion due to overheating.

If there is a suspicion that deposits have gathered inside the vacuum pump the vacuum pump shall be flushed.

- Make sure that all the used oil is drained
- Create 0.3 litres flushing agent from 50 percent oil and 50 percent paraffin or diesel fuel/fuel oil
- Make sure that the drain plug is firmly inserted
- Remove the filling plug
- Fill in the flushing agent
- Firmly reinsert the filling plug
- Close the suction line
- Run the vacuum pump for at least half an hour
- Drain the flushing agent and dispose of it in compliance with applicable regulations

Note: Due to the use of paraffin and even more in case of using diesel fuel/fuel oil, an unpleasant odour can occur after recommissioning. If this is a problem, diesel fuel/fuel oil should be avoided and the vacuum pump be run at idle in a suitable place until the unpleasant odour vanishes.

Filling in Fresh Oil

- Keep 0.3 litres oil acc. to the table Oil (→ page 18) ready

Note: The amount given in these operating instructions is a guide. The sight glass indicates the actual amount to be filled in.

- Make sure that the drain plug is firmly inserted



Filling oil through the suction connection will result in breakage of the vanes and destruction of the vacuum pump.

Oil may be filled through the filling port only.

- Remove the filling plug
- Fill in approx. 0.3 litres of oil
- Make sure that the level is between the MIN and the MAX-markings of the sight glass
- Make sure that the seal ring is inserted into the filling plug and undamaged, replace if necessary
- Firmly reinsert the filling plug together with the seal ring

Exhaust Filter

Checks during Operation

Busch recommends the use of a filter pressure gauge (available as accessory, → page 18: Accessories). Without filter pressure gauge the filter resistance shall be assessed on the basis of the drive motor current drawn.

Version with exhaust filter pressure gauge:

- ◆ Remove the suction line from the suction connection (unrestricted suction!)
- ◆ Make sure that the vacuum pump is running
- ◆ Check that the reading on the filter pressure gauge is in the green field

- ◆ Reconnect the suction line to the suction connection

Version without filter pressure gauge:

- ◆ Make sure that the vacuum pump is running
- ◆ Check that the drive motor current drawn is in the usual range

Version with oil return valve (KA ... C):

Note: The discharged gas will also contain oil if the vacuum pump is operated without interruption for too long a period (→ page 8: Operation Notes).

- Check that the discharged gas is free from oil

Assessment

If

the reading on the filter pressure gauge is in the red field,

or

the drive motor draws too much current and/or the pump flow rate has dropped,

then the exhaust filter is clogged and must be replaced.

Note: Exhaust filters cannot be cleaned successfully. Clogged exhaust filters must be replaced with new ones.

If

the filter pressure gauge indicates a lower pressure than usual,

or

the drive motor draws less current than usual,

then the exhaust filter is broken through and must be replaced.

If the discharged gas contains oil,

the exhaust filter can either be clogged or broken through and, if applicable, must be replaced.

Change of the Exhaust Filter



In case the vacuum pump conveyed gas that was contaminated with harmful foreign material the exhaust filter will be contaminated with harmful material.

Danger to health during the changing of the contaminated exhaust filter.

Danger to the environment.

Wear personal protective equipment during the changing of the contaminated exhaust filter.

Used exhaust filters are special waste and must be disposed of separately in compliance with applicable regulations.



The filter spring can fly out of the exhaust port during removal or insertion.

Risk of eye injury.

Eye protection goggles must be worn while handling filter springs.

Removing the Exhaust Filter

- Make sure that the vacuum pump is shut down and locked against inadvertent start up
- Prior to disconnecting pipes/lines make sure that the connected pipes/lines are vented to atmospheric pressure
- Remove the discharge line, if necessary
- Remove the exhaust cover from the oil separator

- Loosen the screw in the centre of the exhaust filter retaining spring, but do not remove it at this time
- Press the exhaust filter retaining spring out of the indent and rotate it
- Remove the exhaust filter retaining spring from the oil separator
- Pull the exhaust filter out of the oil separator

Inserting the Exhaust Filter



The non-OEM spares market offers exhaust filters that are geometrically compatible with Busch-vacuum pumps, but do not feature the high retention capacity of genuine Busch-exhaust filters and deteriorate the service life and the efficiency of the vacuum pump due to their increased back pressure.

Increased risk of damage to health.

Adverse effect on efficiency and service life.

In order to keep the emission on the lowest possible level and to preserve efficiency and service life only genuine Busch-exhaust filters shall be used.

- Make sure that the new exhaust filter is equipped with a new o-ring
- Insert the exhaust filter such that its port is properly seated in its receptacle in the oil separator
- Make sure that the tip of the screw in the centre of the exhaust filter retaining spring protrudes the retaining spring by about 2 - 5 revolutions
- Insert the exhaust filter retaining spring such that its ends are secured in their receptacles in the oil separator by the protrusions and that the tip of the screw snaps into the indent of the exhaust filter
- Tighten the screw in the exhaust filter retaining spring such that the screw head touches the spring steel sheet
- Make sure that the seal under the exhaust cover is clean and undamaged, if necessary replace with a new seal
- Mount the exhaust cover together with the seal and hex head screws on the oil separator
- If necessary connect the discharge line

Note: During operation the exhaust filter gets saturated with oil. It is therefore normal that the oil level will drop slightly after replacement of the exhaust filter.

Overhaul



In order to achieve best efficiency and a long life the vacuum pump was assembled and adjusted with precisely defined tolerances.

This adjustment will be lost during dismantling of the vacuum pump.

It is therefore strictly recommended that any dismantling of the vacuum pump that is beyond of what is described in this manual shall be done by Busch service.



In case the vacuum pump conveyed gas that was contaminated with harmful foreign material the oil and the exhaust filter(s) will be contaminated with harmful material.

Harmful material can reside in pores, gaps and internal spaces of the vacuum pump.

Danger to health during dismantling of the vacuum pump.

Danger to the environment.

Prior to shipping the vacuum pump shall be decontaminated as good as possible and the contamination status shall be stated in a "Declaration of Contamination" (form downloadable from www.busch-vacuum.com).

Busch service will only accept vacuum pumps that come with a completely filled in and legally binding signed "Declaration of Contamination" (form downloadable from www.busch-vacuum.com).

Removal from Service

Temporary Removal from Service

- Prior to disconnecting pipes/lines make sure that all pipes/lines are vented to atmospheric pressure

Recommissioning



Vanes can stick after a long period of standstill.

Risk of vane breakage if the vacuum pump is started with the drive motor.

After longer periods of standstill the vacuum pump shall be turned by hand.

After longer periods of standstill:

- ◆ Make sure that the vacuum pump is locked against inadvertent start up
- ◆ Remove the cover around the fan of the drive motor
- ◆ Slowly rotate the fan wheel by hand several revolutions in the intended direction of rotation (see stuck on or cast arrow)
- ◆ Mount the cover around the fan wheel of the drive motor

If deposits could have gathered in the vacuum pump:

- ◆ Flush the vacuum pump (→ page 9: Maintenance)
- Observe the chapter Installation and Commissioning (→ page 6)

Dismantling and Disposal



In case the vacuum pump conveyed gas that was contaminated with harmful foreign material the oil and the exhaust filter(s) will be contaminated with harmful material.

Harmful material can reside in pores, gaps and internal spaces of the vacuum pump.

Danger to health during dismantling of the vacuum pump.

Danger to the environment.

During dismantling of the vacuum pump personal protective equipment must be worn.

The vacuum pump must be decontaminated prior to disposal.

Oil and exhaust filters must be disposed of separately in compliance with applicable regulations.



Used oil and used exhaust filters are special waste and must be disposed of in compliance with applicable regulations.



The filter spring can fly out of the exhaust port during removal.

Risk of eye injury.

Eye protection goggles must be worn while handling filter springs.

- Remove the exhaust filter (→ page 10: Exhaust Filter)
- Drain the oil
- Make sure that materials and components to be treated as special waste have been separated from the vacuum pump
- Make sure that the vacuum pump is not contaminated with harmful foreign material

According to the best knowledge at the time of printing of this manual the materials used for the manufacture of the vacuum pump involve no risk.

- Dispose of the used oil in compliance with applicable regulations
- Dispose of special waste in compliance with applicable regulations
- Dispose of the vacuum pump as scrap metal

Troubleshooting



WARNING

Risk of electrical shock, risk of damage to equipment.

Electrical installation work must only be executed by qualified personnel that knows and observes the following regulations:

- IEC 364 or CENELEC HD 384 or DIN VDE 0100, respectively,
- IEC-Report 664 or DIN VDE 0110,
- BGV A2 (VBG 4) or equivalent national accident prevention regulation.



CAUTION

During operation the surface of the vacuum pump may reach temperatures of more than 70 °C.

Risk of burns!

Let the vacuum pump cool down prior to a required contact or wear heat protection gloves.

Problem	Possible Cause	Remedy
<p>The vacuum pump does not reach the usual pressure</p> <p>The drive motor draws a too high current (compare with initial value after commissioning)</p> <p>Evacuation of the system takes too long</p>	The vacuum system or suction line is not leak-tight	Check the hose or pipe connections for possible leak
	In case a vacuum relief valve/regulating system is installed: The vacuum relief valve/regulating system is misadjusted or defective	Adjust, repair or replace, respectively
	Contaminated oil (the most common cause)	Change the oil (→ page 9: Maintenance)
	No or not enough oil in the reservoir	Top up oil (→ page 9: Maintenance)
	The exhaust filter is partially clogged	Replace the exhaust filter (→ page 9: Maintenance)
	The screen in the suction connection is partially clogged	Clean the screen If cleaning is required too frequently install a filter upstream
	In case a filter is installed on the suction connection: The filter on the suction connection is partially clogged	Clean or replace the inlet air filter, respectively
	Partial clogging in the suction, discharge or pressure line	Remove the clogging
	Long suction, discharge or pressure line with too small diameter	Use larger diameter
	The valve disk of the inlet non-return valve is stuck in closed or partially open position	Disassemble the inlet, clean the screen and the valve as required and reassemble
	The oil tubing is defective or leaking The oil return line is broken	Tighten the connections Replace the connections and/or the tubing (replace with identically dimensioned parts only)
	A shaft seal is leaking	Replace the shaft seal ring (Busch service)
	An/The exhaust valve is not properly seated or stuck in partially open position	Disassemble and reassemble the exhaust valve(s) (Busch service)

	A vane is blocked in the rotor or otherwise damaged	Free the vanes or replace with new ones (Busch service)
	The radial clearance between the rotor and the cylinder is no longer adequate	Readjust the vacuum pump (Busch service)
	Internal parts are worn or damaged	Repair the vacuum pump (Busch service)
	<p>Version with oil return line to the suction connection (KC C):</p> <p>The oil return line starts in an area vented to atmospheric pressure. Particularly on small model pumps, a fairly large amount of air is sucked through the oil return line, which may prevent the ultimate pressure from reaching 20 bar abs.</p> <p>In order to exclude this possible cause:</p> <p>either</p> <p>temporarily disconnect the oil return line from its connection near the exhaust opening and close it</p> <p>or</p> <p>squirt oil through the gas discharge</p>	
The gas conveyed by the vacuum pump smells displeasing	<p>Process components evaporating under vacuum</p> <p>Readily volatile and thus gaseous components of the oil, e.g. additives, particularly right after an oil change.</p> <p>Note: This is no indication of a malfunction of the oil separator. The oil separator is able to retain droplets of oil, however no gaseous components of it.</p>	<p>Check the process, if applicable</p> <p>Use a different type of oil, if applicable</p>
The vacuum pump does not start	The drive motor is not supplied with the correct voltage or is overloaded	Supply the drive motor with the correct voltage
	The drive motor starter overload protection is too small or trip level is too low	<p>Compare the trip level of the drive motor starter overload protection with the data on the nameplate, correct if necessary</p> <p>In case of high ambient temperature: set the trip level of the drive motor starter overload protection 5 percent above the nominal drive motor current</p>
	One of the fuses has blown	Check the fuses
	Version with alternating current motor: The drive motor capacitor is defective	Repair the drive (Busch service)
	The connection cable is too small or too long causing a voltage drop at the vacuum pump	Use sufficiently dimensioned cable
	The vacuum pump or the drive motor is blocked	<p>Make sure the drive motor is disconnected from the power supply</p> <p>Remove the fan cover</p> <p>Try to turn the drive motor with the vacuum pump by hand</p> <p>If the vacuum pump is blocked:</p> <p>Repair the vacuum pump (Busch service)</p>
	The drive motor is defective	Replace the drive motor (Busch service)
The vacuum pump is blocked	Solid foreign matter has entered the vacuum pump	<p>Repair the vacuum pump (Busch service)</p> <p>Make sure the suction line is equipped with a screen</p> <p>If necessary additionally provide a filter</p>
	Corrosion in the vacuum pump from remaining condensate	<p>Repair the vacuum pump (Busch service)</p> <p>Check the process</p> <p>Observe the chapter Conveying Condensable Vapours (→ page 8)</p>

	Version with three-phase motor: The vacuum pump was run in the wrong direction	Repair the vacuum pump (Busch service) When connecting the vacuum pump make sure the vacuum pump will run in the correct direction (→ page 7: Installation)
	After shutting down the vacuum pump the vacuum system exerted underpressure onto the pump chamber which sucked back excessive oil from the oil separator into the pump chamber When the vacuum pump was restarted too much oil was enclosed between the vanes Oil could not be compressed and thus broke a vane	Repair the vacuum pump (Busch service) Make sure the vacuum system will not exert underpressure onto the shut-down vacuum pump, if necessary provide an additional shut-off valve or non-return valve
	After shutting down the vacuum pump condensate ran into the pump chamber When the vacuum pump was restarted too much condensate was enclosed between the vanes Condensate could not be compressed and thus broke a vane	Repair the vacuum pump (Busch service) Make sure no condensate will enter the vacuum pump, if necessary provide a drip leg and a drain cock Drain condensate regularly
The vacuum pump starts, but labours or runs noisily or rattles The drive motor draws a too high current (compare with initial value after commissioning)	Loose connection(s) in the drive motor terminal box Version with three-phase-motor: Not all drive motor coils are properly connected The drive motor operates on two phases only	Check the proper connection of the wires against the connection diagram Tighten or replace loose connections
	Version with three-phase motor: The vacuum pump runs in the wrong direction	Verification and rectification → page 6: Installation and Commissioning
	Standstill over several weeks or months	Let the vacuum pump run warm with inlet closed
	Oil viscosity is too high for the ambient temperature	Use synthetic oil, if necessary use oil of the next lower viscosity class (CAUTION: operation with too low viscosity can cause chatter marks inside the cylinder) Warm up the oil with a heater prior to starting up the vacuum pump, or run the vacuum pump in intervals in order not to let it get too cold
	Improper oil quantity, unsuitable oil type	Use the proper quantity of one of the recommended oils (→ page 18: Oil change: → page 9: Maintenance)
	No oil change over extended period of time	Perform oil change incl. flushing (→ page 9: Maintenance)
	The exhaust filter is clogged and appears black from burnt oil	Flush the vacuum pump Replace the exhaust filter Fill in new oil (→ page 9: Maintenance) In case the oil life is too short: use oil with better heat resistance (→ page 18: Oil) or retrofit cooling
	Foreign objects in the vacuum pump Broken vanes Stuck bearings	Repair the vacuum pump (Busch service)
The vacuum pump runs very noisily	Defective bearings	Repair the vacuum pump (Busch service)
	Stuck vanes	Repair the vacuum pump (Busch service) Use only recommended oils (→ page 18: Oil) and change more frequently

The vacuum pump runs very hot (the oil sump temperature shall not exceed 100 °C)	Insufficient air ventilation	Make sure that the cooling of the vacuum pump is not impeded by dust/dirt Clean the fan cowling, the fan wheel, the ventilation grille and the cooling fins Install the vacuum pump in a narrow space only if sufficient ventilation is ensured On a vacuum pump with oil-cooler: clean the intermediate spaces of the finned tube
	Ambient temperature too high	Observe the permitted ambient temperatures
	Temperature of the inlet gas too high	Observe the permitted temperatures for the inlet gas
	The exhaust filter is partially clogged	Replace the exhaust filter
	Not enough oil in the reservoir	Top up oil
	Oil burnt from overheating	Flush the vacuum pump Replace the exhaust filter Fill in new oil (→ page 9: Maintenance) In case the oil life is too short: use oil with better heat resistance (→ page 18: Oil) or retrofit cooling
	Mains frequency or voltage outside tolerance range	Provide a more stable power supply
	Partial clogging of filters or screens Partial clogging in the suction, discharge or pressure line	Remove the clogging
The vacuum pump fumes or expels oil droplets through the gas discharge The oil level drops	Long suction, discharge or pressure line with too small diameter	Use larger diameter
	The exhaust filter is not properly seated	Check the proper position of the exhaust filter, if necessary insert properly (→ page 9: Maintenance)
	The o-ring is missing or damaged	Add or replace resp. the o-ring (→ page 9: Maintenance)
	The exhaust filter shows cracks	Replace the exhaust filter (→ page 9: Maintenance)
	The exhaust filter is clogged with foreign matter Note: The saturation of the exhaust filter with oil is no fault and does not impair the function of the exhaust filter! Oil dropping down from the exhaust filter is returned to the oil circulation.	Replace the exhaust filter (→ page 9: Maintenance)
	Version with oil return valve (KA ... C): In case the vacuum pump runs for more than 2 hours without interruption, oil can collect in the upper chamber of the oil separator to an extent that it gets expelled together with the discharged gas	Regularly shut down the vacuum pump for short periods of time. Check that the oil return valve functions properly and lets oil run from the upper into the bottom chamber of the oil separator as soon as the vacuum pump is shut down (→ page 4: Oil Circulation)
	Version with oil return valve (KA ... C): The oil return valve does not work properly or is clogged (proper function is when blowing into the valve it should close, when vacuum is applied, the valve should open; CAUTION: do not let your mouth get in direct contact with the oil return valve, do not inhale through the oil return valve!)	Clean or replace the oil return valve

	The oil return line is clogged or broken	Clean a clogged oil return line Replace a broken oil return line with an identically dimensioned line, top up oil (if necessary by Busch service)
The oil is black	Oil change intervals are too long The oil was overheated	Flush the vacuum pump Replace the exhaust filter Fill in new oil (→ page 9: Maintenance) In case the oil life is too short: use oil with better heat resistance (→ page 18: Oil) or retrofit cooling
The oil is watery and coloured white	The vacuum pump aspirated water or significant amounts of humidity Version with gas ballast: The filter of the gas ballast is clogged	Flush the vacuum pump Replace the exhaust filter Fill in new oil (→ page 9: Maintenance) Modify the operational mode (→ page 8: Operating Notes → Conveying Condensable Vapours) Version with gas ballast with paper filter: Replace the filter
The oil is resinous and/or sticky	Improper oil type, perhaps in confusion Topping up of incompatible oil	Flush the vacuum pump Replace the exhaust filter Fill in new oil (→ page 9: Maintenance) Make sure the proper oil is used for changing and topping up
The oil foams	Mixing of incompatible oils	Flush the vacuum pump Replace the exhaust filter Fill in new oil (→ page 9: Maintenance) Make sure the proper oil is used for topping up

Spare Parts Kits

Note: When ordering spare parts or accessories acc. to the table below please always quote the type ("Type") and the serial no. ("No") of the vacuum pump. This will allow Busch service to check if the vacuum pump is compatible with a modified or improved part.

The exclusive use of genuine spare parts and consumables is a pre-requisite for the proper function of the vacuum pump and for the granting of warranty, guarantee or goodwill.

This parts list applies to a typical configuration of the vacuum pump KA/KC 0010,0016 C. Depending on the specific order deviating parts data may apply.

Your point of contact for service and spare parts in the United Kingdom:

Busch (UK) Ltd.
Hortonwood 30-35
Telford
Shropshire
TF1 7YB
Tel: 01952 677 432
Fax: 01952 677 423

Your point of contact for service and spare parts in Ireland:

Busch Ireland Ltd.
A10-11 Howth Junction Business Centre
Kilbarrack, Dublin 5
Tel: +353 (0)1 8321466
Fax: +353 (0)1 8321470

Your point of contact for service and spare parts in the USA:

Busch Inc.
516-B Viking Drive
Virginia Beach, VA 23452
Tel: 1-800-USA-PUMP (872-7867)

Your point of contact for service and spare parts in Canada:

Busch Vacuum Technics Inc.
1740, Boulevard Lionel Bertrand
Boisbriand (Montréal)
Québec J7H 1N7
Tel: 450 435 6899
Fax: 450 430 5132

Your point of contact for service and spare parts in Australia:

Busch Australia Pty. Ltd.
30 Lakeside Drive
Broadmeadows, Vic. 3047
Tel: (03) 93 55 06 00
Fax: (03) 93 55 06 99

Your point of contact for service and spare parts in New Zealand:

Busch New Zealand Ltd.
Unit D, Arrenway Drive
Albany, Auckland 1311
P O Box 302696
North Harbour, Auckland 1330
Tel: 0-9-414 7782
Fax: 0-9-414 7783

Find the list of Busch companies all over the world (by the time of the publication of these installation and operating instructions) on → page 20 (rear cover page).

Find the up-to-date list of Busch companies and agencies all over the world on the internet at www.busch-vacuum.com.

Spare parts kit	Description	Part no.
Service kit	consisting of exhaust filter and pertinent seals	0992 106 535
Set of seals/gaskets	consisting of all necessary seals	0990 149 224
Overhaul kit	consisting of seal set and all wearing parts	0993 149 225

Accessories

Accessories	Description	Part no.
Inlet air filter	inlet-side, vertical, with paper cartridge, to separate solids	0945 000 130
Inlet air filter	inlet-side, horizontal, with paper cartridge, to separate solids	0945 000 131
Inlet air filter	inlet-side, vertical, with polyester cartridge, food proof, to separate solids	0945 121 871
Inlet air filter	inlet-side, horizontal, with polyester cartridge, food proof, to separate solids	0945 121 872
Filter pressure gauge	for easy checking of the degree of clogging of the exhaust filter	0946 000 100
Exhaust cover plate with connection thread	connection thread G½"	0947 119 875
Vacuum regulating unit	to adjust the required working pressure	0947 000 438
Gas ballast, complete	for the conveying of condensable vapours, with paper filter	0916 106 678

Oil

Denomination	VM 068	VSL 032
ISO-VG	68	32
Base	Mineral oil	PAO
Density [g/cm³]	0.884	0.83
Kinematic viscosity at 40 °C [mm²/s]	68	32
Kinematic viscosity at 100 °C [mm²/s]	8.5	6
Flashpoint [°C]	235	240
Pourpoint [°C]	-15	-60
Part no. 1 l packaging	0831 102 492	0831 122 575
Part no. 5 l packaging	0831 102 493	0831 131 845
Remark	3phase motor	Food applications (NSF H1); AC motor
Filling quantity, approx. [l]	0.3	

EC-Declaration of Conformity

Note: This Declaration of Conformity and the **CE**-mark affixed to the nameplate are valid for the vacuum pump within the Busch-scope of delivery. When this vacuum pump is integrated into a superordinate machinery the manufacturer of the superordinate machinery (this can be the operating company, too) must conduct the conformity assessment process acc. to the Directive Machinery 2006/42/EC for the superordinate machine, issue the Declaration of Conformity for it and affix the **CE**-mark.

We

Busch Produktions GmbH
Schauinslandstr. 1
79689 Maulburg
Germany

declare that vacuum pumps **KA/KC 0010,0016 C**

in accordance with the European Directives:

- “Machinery” 2006/42/EC,
- “Electrical Equipment Designed for Use within Certain Voltage Limits” (so called “Low Voltage”) 2006/95/EC,
- “Electromagnetic Compatibility” 2004/108/EC,

have been designed and manufactured to the following specifications:

Standard	Title of the Standard
Harmonised Standards	
EN ISO 12100-1 EN ISO 12100-2	Safety of machinery - Basic concepts, general principles of design - Part 1 and 2
EN ISO 13857	Safety of machinery - Safety distances to prevent hazard zones being reached by the upper and lower limbs
EN 1012-1 EN 1012-2	Compressors and vacuum pumps - Safety requirements - Part 1 and 2
EN ISO 2151	Acoustics - Noise test code for compressors and vacuum pumps - Engineering method (grade 2)
EN 60204-1	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
EN 61000-6-1 EN 61000-6-2	Electromagnetic compatibility (EMC) - Generic immunity standards
EN 61000-6-3 EN 61000-6-4	Electromagnetic compatibility (EMC) - Generic emission standards

Manufacturer



Dr.-Ing. Karl Busch
General director

Person authorised to compile
the technical file



Andrej Riwe
Technical writer

Busch – All over the World in Industry

Australia

Busch Australia Pty. Ltd.
30 Lakeside Drive
Broadmeadows, Vic. 3047
Tel: (03) 93 55 06 00
Fax: (03) 93 55 06 99

Austria

Busch Austria GmbH
Industriepark Nord
2100 Korneuburg
Tel: 02262 / 756 65-0
Fax: 02262 / 756 65-20

Belgium

Busch N.V./Busch SA
Kruinstraat 7
9160 Lokeren
Tel: (0)9 / 348 47 22
Fax: (0)9 / 348 65 35

Brazil

Busch do Brasil Ltda.
Rod. Edgard Máximo Zambotto, Km 64
13240-000 Jarinu-SP
Tel: (55) 11-4016 1400/5277
Fax: (55) 11-4016 5399

Canada

Busch Vacuum Technics Inc.
1740, Boulevard Lionel Bertrand
Boisbriand (Montréal)
Québec J7H 1N7
Tel: 450 435 6899
Fax: 450 430 5132

Chile

Busch Chile S. A.
Calle El Roble N° 375-G
Lampa - Santiago
Tel: (56-2) 7387092
Fax: (56-2) 7387092

China

Busch Vacuum (Shanghai) Co., Ltd
No.5, Lane 195 Xipu Road
Songjiang Industrial Estate East New Zone
Shanghai 201611 PRC
Tel: +86 (0)21 67600800
Fax: +86 (0)21 67600700

Czech Republic

Busch Vakuum s.r.o.
Pražákova 10
619 00 Horní Heršpice
Brno
Tel: +420 543 42 48 55
Fax: +420 543 42 48 56

Denmark

Busch Vakuumtechnik A/S
Parallelvej 11
8680 Ry
Tel: +45 87 88 07 77
Fax: +45 87 88 07 88

Finland

Busch Vakuumtechnik Oy
Sinikellontie 4
01300 VANTAA
Tel: 09 774 60 60
Fax: 09 774 60 666

France

Busch France S.A.
Parc Technologique
de Bois Chaland CE 2922
91029 Evry Cedex
Tel: 01 69 89 89 89
Fax: 01 60 86 16 74

Germany

Dr.-Ing. K. Busch GmbH
Schauinslandstr. 1
79689 Maulburg
Tel: (0 76 22) 6 81-0
Fax: (0 76 22) 6 81-194
e-mail: info@busch.de

Dr.-Ing. K. Busch GmbH
Niederlassung Nord
Ernst-Abbe-Str. 1-3
25451 Quickborn
Tel: (0 41 06) 7 99 67-0
Fax: (0 41 06) 7 99 67-77

Dr.-Ing. K. Busch GmbH
Niederlassung West
Nordring 35
64807 Dieburg
Tel: (0 60 71) 92 82-0
Fax: (0 60 71) 14 71

Dr.-Ing. K. Busch GmbH
Außenstelle Neuenrade
Breslauer Str. 36
58809 Neuenrade
Tel: (0 23 92) 50 29 92
Fax: (0 23 92) 50 72 11

Dr.-Ing. K. Busch GmbH
Niederlassung Süd-Ost
Gewerbestraße 3
90579 Langenzenn
Tel: (09 01) 90 25-0
Fax: (09 01) 90 25-25

Dr.-Ing. K. Busch GmbH
Außenstelle Zella-Mehlis
Am Rain 11
98544 Zella-Mehlis
Tel: (0 36 82) 46 92 71
Fax: (0 36 82) 46 92 73

Dr.-Ing. K. Busch GmbH
Außenstelle Meitingen-Ostendorf
Grünteweg 8
86405 Meitingen-Ostendorf
Tel: (0 82 71) 426-341
Fax: (0 82 71) 426-342

India

Busch Vacuum India Pvt Ltd.
Plot No. 110, Sector 7
PCNTDA, Bhosari
Pune 411026, Maharashtra
Tel: (0)206410 2886
Fax: (0)202711 2838

Ireland

Busch Ireland Ltd.
A10-11 Howth Junction Business Centre
Kilbarrack, Dublin 5
Tel: 00353 1 832 1466
Fax: 00353 1 832 1470

Israel

Busch Israel Ltd.
1 Mevo Sivan Street
Qiryat Gat 82022, Israel
Tel: +972 (0)8 6810485
Fax: +972 (0)8 6810486

Italy

Busch Italia S.r.l.
Via Ettore Majorana, 16
20054 Nova Milanese
Tel: 0362 370 91
Fax: 0362 370 999

Japan

Nippon Busch K.K.
1-23-33, Megumigaoka
Hiratsuka City, Kanagawa
Japan 259-1220
Tel: 0463-50-4000
Fax: 0463-50-4004

Korea

Busch Korea Ltd.
392-1 Yangji-Ri, Yangji-Myun,
Yongin-si, Kyunggi-Do
Tel: (031) 321-8114
Fax: (031) 321 4330

Malaysia

Busch (Malaysia) Sdn Bhd.
6 Jalan Taboh 33/22
Shah Alam Technology Park
Section 33
40400 Shah Alam
Selangor D. E.
Tel: 03 5122 2128
Fax: 03 5122 2108

Mexico

Busch Vacuum Mexico S de RL de CV
Tlaquepaque 4865, Los Altos
Monterrey, Nuevo Leon
Mexico 64370
Tel: (81) 8311-1385
Fax: (81) 8311-1386

Netherlands

Busch B.V.
Pompomolenlaan 2
3447 GK Woerden
Postbus 2091
3440 DB Woerden
Tel: (0)348 - 462300
Fax: (0)348 - 422939

www.busch-vacuum.com

New Zealand

Busch New Zealand Ltd.
Unit D, 41 Arrenway Drive
Albany 0632
Auckland
Tel: 09 414 7782
Fax: 09 414 7783

Norway

Busch Vakuumteknikk AS
Hestehagen 2
1440 Drøbak
Tel: 64 98 98 50
Fax: 64 93 66 21

Poland

Busch Polska Sp. z o.o.
Ul. Chopina 27
87800 Włocławek
Tel: (054) 2315400
Fax: (054) 2327076

Portugal

Busch Ibérica S.A., Sucursal em Portugal
Zona Industrial Raso de Travassô, Fracção B, Armazém 2
3750-753 Agueda
Aveiro, Portugal
Tel: +351 234 648 070
Fax: +351 234 648 068

Singapore

Busch Vacuum Singapore Pte Ltd
20 Shaw Road
#01-03 Ching Shine Building
Singapore 36 79 56
Tel: (65) 6488 0866
Fax: (65) 6288 0877

Spain

Busch Ibérica S.A.
C/ Jaume Ferran, 6-8
Pol. Ind. Coll de la Manyà
08403 Granollers
Tel: +34 93 861 61 60
Fax: +34 93 840 91 56

Sweden

Busch Vakuumteknik AB
Bråta Industriområde
435 33 Mölnlycke
Tel: 031 - 338 00 80
Fax: 031 - 338 00 89

Switzerland

Busch AG
Waldweg 22
4312 Magden
Tel: 061 / 845 90 90
Fax: 061 / 845 90 99

Taiwan

Busch Taiwan Corporation
1F. No. 69, Sec. 3, Beishen Rd.
Shenkeng Township,
Taipei Country,
Taiwan (222), R.O.C
Tel: (02) 2662 0775
Fax: (02) 2662 0796

Thailand

Busch Vacuum (Thailand) Co., Ltd.
888/30 Moo19, Soi Yingcharoen, Bangplee-Tamru Rd.,
Bangpleeyai, Bangplee, Samutprakarn 10540 Thailand
Tel: (66) 2-382-5428
Fax: (66) 2-382-5429

Turkey

VAKUTEK
Emlak Kredi Ishani No: 179
81130 Üsküdar-Istanbul
Tel: (216) 310 0573
Fax: (216) 343 5126

United Kingdom

Busch (UK) Ltd
Hortonwood 30-35
Telford Shropshire TF1 7YB
Tel: 01952 677 432
Fax: 01952 677 423

USA

Busch, Inc.
516-B Viking Drive
Virginia Beach, VA 23452
Tel: (757) 463-7800
Fax: (757) 463 7407

Semiconductor Vacuum Group Inc.
Morgan Hill, CA 95037
Tel: (408) 955 1900
Fax: (408) 955 0229



Смазки и температура использования для вакуумного насоса Busch KA 0016 C

VSL 068 (KA 0016 C) Заказной номер Dilo: 3-690-R221 (1 литр)

Температура окр. среды: +8 °C to +40 °C Смазка, рекомендованная Busch: VSL 068

удельный вес при +15°C	0.83 г/см ³
кинематическая вязкость при 40°C	68 мм ² /с (сСт)
кинематическая вязкость при 100°C	10 мм ² /с (сСт)
точка воспламенения	240 °C
температура текучести	-55 °C

Масло VSL для вакуумного насоса Busch является синтетическим смазочным материалом на полиолефиновой масляной основе и одобрено NSF/H1 (Национальный Санитарный Фонд) в соответствии с нормами FDA (Управление по контролю за продуктами и лекарствами). Этим маслом можно пользоваться в течение всего года, и оно обладает очень высокой температурной устойчивостью и низкой температурой текучести.

В дополнение к этому перечню «Специальные масла» может быть использован список Busch.